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A
Philoſophical Account
OF THE
WORKS of NATURE:

As Founded upon

A PLAN of the late Mr. ADDISON.

CONTAINING,

I. The ſeveral Gradations remarkable in the Mineral, Vegetable, and Animal Parts of the Creation; tending to the Compoſition of a Scale of Life.

II. A Repreſentation of the preſent State of Gardening throughout *Europe* in general, and *Great Britain* in particular.

III. New Experiments relating to the Improvement of Barren Grounds, Timber-Trees, Fruit-Trees, Vines, Sallads, Pulſe, and all Kinds of Grain.

IV. Obſervations on the Huſbandry of *Flanders*, in ſowing Flax, whereby Land may be advanced *Cent. per Cent.*

By *RICHARD BRADLEY*, F.R.S.
Profeſſor of Botany in the Univerſity of *Cambridge*.

K

Adorned with many CURIOUS CUTS, Drawn and Engraven by the beſt MASTERS.

> *——All their known Virtue appears*
> *Productive in Herb, Plant, and nobler Birth*
> *Of Creatures animate with gradual Life.*
> *Of Growth, Senſe, Reaſon——* MILTON.

THE SECOND EDITION,
Reviſed, Corrected, and greatly Augmented.

LONDON:
Printed for JAMES HODGES, at the *Looking-Glaſs* on
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1739
Price Six Shillings.

To the Right Honourable

CHARLES,

EARL of *ORRERY*,

Knight of the Moſt Antient Order of the THISTLE, *&c.*

My LORD,

YOUR Lordſhip's Approbation of the following Work, is ſufficient to gain it a favourable Reception with the Learned World: For as that Part of Mankind is unanimous in Opinion of Your Lordſhip's Accurate Judgment in all Kinds of Learning; ſo whatever appears under *Your* Patronage, muſt neceſſarily engage an univerſal Eſteem.

And this, My Lord, is the Happineſs I reap from thoſe Labours which I deſign for general Uſe, to ſee them ſupported by ſo Noble and Learned a Patron; and to have the Honour of declaring to the World in this publick Manner, that I am, with the greateſt Reſpect,

My LORD,

Your Lordſhip's

Moſt Devoted, and

Moſt Humble Servant,

RICHARD BRADLEY.

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INTRODUCTION.

THE Great Mr. *Addiſon*, (whoſe Memory will ever be revered by the Learned and Curious Part of Mankind, for the excellent Leſſons he has given the World) among other inſtructive Pieces, has ſo beautifully repreſented ſome of the Remarkables in Nature's Works, that it is reaſonable to believe a Continuance of his Life would have furniſhed us with ſuch a *Natural Hiſtory*, as would have been uſeful to Men of all Kinds of Learning.

This Learned Gentleman, in the *Spectator*, N° 121, gives us his Opinion concerning Natural Hiſtory, in the following Words:

" I could wiſh our *Royal Society* would " compile a Body of Natural Hiſtory, the beſt " that could be gather'd together from Books " and Obſervations. If the ſeveral Writers a" mong them took each his particular Species, " and gave us a diſtinct Account of its Original, " Birth, and Education; its Policies, Hoſtili-

" ties, and Alliances, with the Frame and
" Texture of its inward and outward Parts;
" and particularly thoſe which diſtinguiſh it
" from all other Animals; with their peculiar
" Aptitudes for the State of Being, in which
" Providence has placed them; it would be
" one of the beſt Services their Studies could
" do Mankind, and not a little redound to the
" Glory of the All-wiſe Contriver.

I am proud to own in this Place, that it was Mr. *Addiſon* who firſt gave me this curious Thought, and led me to the Compoſition of the following Treatiſe, which, however I have been fortunate in putting together, I can venture to affirm it conſiſts of Truth ſo far as I have mention'd any Thing upon my own Knowledge. But as the World, in Caſes of this Nature, is commonly jealous of the Facts related, I have here given my Reader an Opportunity of ſurveying the ſeveral Curioſities I have mention'd, by directing him to thoſe Cabinets where each reſpective Subject is lodg'd.

It is not to be expected, that, in ſo ſmall a Work, I can give a full Relation of the Exterior and Interior Parts of Bodies; nor can it be ſuppoſed that even It could contain the Names of every different *Mineral Plant*, or *Animal* that is commonly known; for it is true, (as Mr. *Addiſon* obſerves in the above-mention'd Paper) " That a Natural Hiſtory, after all the
" Diſquiſitions of the Learned, would be infinite-
" ly ſhort and defective. Seas and Deſarts hide
" Mil-

“ Millions of *Animals* from our Obſervation; innumerable Artifices and Stratagems are acted in the *howling Wilderneſs*, and in the *great Deep*, that can never come to our Knowledge. Beſides that, there are infinitely more Species of Creatures, which are not to be ſeen without, nor indeed with the Help of the fineſt Glaſſes, than of ſuch as are bulky enough for the naked Eye to take hold of. However, from the Conſideration of ſuch *Animals* as lie within the Compaſs of our Knowledge, we might eaſily form a Concluſion of the reſt, that the ſame Variety of Wiſdom and Goodneſs runs through the whole Creation, and puts every Creature in a Condition to provide for its Safety and Subſiſtence in its proper Station.”

From this uſeful Plan for *Natural Hiſtory*, I have endeavoured to lay the Foundation of my Building, and ſhall account myſelf happy enough, if among the Parts I have touched upon I have hit on any Thing new and uſeful, which may contribute to advance ſo beneficial an Undertaking.

LONDON,
1721.

R. B.

A
PHILOSOPHICAL ACCOUNT
OF THE
WORKS of NATURE.

CHAP. I.

Of the moſt remarkable Appearances in EARTHS *and* MINERAL BODIES.

I PROPOSE, *firſt*, to treat of *Earths* and *Mineral* Bodies, ſuppoſing them to ſubſiſt much longer without any conſiderable Alteration of Parts, than any other of the created Bodies. *Vegetables*, *Animals*, and *Inſects* have reſpectively their Modes of Growth very different from one another, each of them undergoing viſible Alterations till they are perfect; but *Earths* and *Mineral* Bodies require Length of Time to perfect themſelves in their reſpective Stations: Which Time of their Tendency to Perfection I ſhall, for the Eaſe of ſome of my Readers, call the Time of their Growth.

What I here call *Earth*, is whatever Soil I find in the ſuperficial and ſecond *Strata*, ſuch as may be uſed for the Propagation of Vegetables; perhaps in ſome Caſes we may even uſe the third *Stratum* for the Profit of Plants; but all the *Strata* below this I ſhall ſuppoſe are ſo many Beds of Mineral Matter, either in a State of Solution, or Conſolidation, or elſe hardened as much as ever they will be.

It would be tedious to enumerate every Particular which might be obſerved in all the *Earths* that are uſed for the Production of *Vegetables*; there are undoubtedly many thouſand different Mixtures, which have either been made deſignedly, or have happened by Accident. It will ſuffice for my preſent Purpoſe to diſtinguiſh them under *three* General Heads, as *Sand*, *Loam*, and *Clay*; for all *Earths* are in ſome Degree or other partaking of theſe; and it is my Opinion that they all originally were made up of *Sandy*-Particles, but varied only in their Powers, by mixing with Liquids of different Qualities, (*i. e.*) ſuch as are *Aqueous*, *Viſcous*, and *Oleaginous*.

The Particles of *Sand* which compoſe *Earth* are not all of the ſame Dimenſions; ſome are big enough to be obſerved diſtinctly by the naked Eye, while others are ſcarcely to be diſcerned with the Microſcope; yet every one of theſe Parts, however ſmall it is, may (I ſuppoſe)

poſe) loſe of it Bulk and Weight, or add to both, by being expoſed to different Degrees of Heat; and ſo conſequently when many of them are united, that united Body will ſtill maintain ſo much of the natural Diſpoſition of the Parts it was compoſed of, that a certain Degree of Heat would have the ſame Effect upon it, that it would proportionably have upon the leaſt Particle of its Compoſition; for even a *Diamond*, which is the hardeſt *Gem* known in the World, will loſe a Share of its Weight by means of a powerful *Burning-Glaſs*; an Inſtance of which we find in *Phil. Tranſactions*, Nº 360, where, in the Account of Experiments made with Mr. *Villette*'s Burning-Concave in *June* 1718, by the Reverend Dr. *Harris* and Dr. *Deſaguliers*, we find that a *Diamond* weighing 4 Grains, loſt 7 Eighths of its Weight, an *Emerald* was melted into a Subſtance like a *Turky-Stone*, the *Aſbeſtos* ſeemed condenſed a little in 28 Seconds, but it was then ſomething cloudy: Mr. *Villette* ſays that the Glaſs uſually calcines it. A *Copper* Halfpenny melted in 20 Seconds, a Sixpence in 7 Seconds and ½; Tin melted in 3 Seconds; Caſt-Iron, in 16 Seconds; Slate, in 3 Seconds; Tile, in 4 Seconds, and vitrified thorough in 80; Bone calcined in 4 Seconds, and vitrified thorough in 33; *Calculus-Humanus* calcined in 2 Seconds; Talk began to calcine in 40 Seconds, and a Foſſile-Shell in 7 Seconds; Chalk fled away in 23 Seconds.

N. B. *Mr.* Villette's *Mirour is a* Concave *of* 47 *Inches wide, and ground to a* Sphere *of* 76 *Inches* Radius, *ſo that its* Focus *is about* 38 *Inches diſtant from the* Vertex *of the Glaſs.*

From whence it appears, that every Mineral or other Body, as it is more or leſs conſolidated or hardened, is more or leſs ſubject to the Impreſſions made by Heat or Cold; and this I mention the rather, becauſe I would offer a *Query*, whether if theſe Parts of *Sand*, *&c.* being ſubject to dilate or contract, may not by means of their *Pores* receive a kind of nouriſhing or improving Juice from the next neighbouring *Liquid*, and by that Help in a long Series of Years ſwell and become larger than we might ſuppoſe them at firſt. If this were allowed, we might then ſuppoſe *Mineral Bodies* had a kind of Growth, and even hope to diſcover the Mode of Generation of *Minerals* or *Stones*; which Work, I am informed, the celebrated *Malphigius* had began.

But further; divide 3 Pounds of *Sand* into 3 Parcels, well dried, and make each Parcel into a Paſte, the *firſt* with common Water, the *ſecond* with ſome viſcous Matter, ſuch as a Solution of *Soap* and Water, or a kind of *Liquid-Soap*, and the *third* with *Oil*, and lay them for ſome Time expoſed to the Sun; the *Sand* and *Water*, as it dries, will fall to Pieces, or ſeparate with a ſmall Breath of Air; the

Soap and *Sand* will be more retentive, and will not ſeparate without ſome Difficulty; and the *Oil* and *Sand* will be baked ſo hard, as to require a conſiderable Force to divide its Parts from one another.

I ſuppoſe then that the 3 ſeveral Soils I have mentioned, *viz. Sand*, *Loam*, and *Clay*, are all of them compoſed of *Sandy* Particles, but differently mix'd with Liquids analogous to thoſe I have mentioned, and by that means are more or leſs binding.

All Kinds of *Sandy-Soil* are nouriſhed with *watery* Parts.

Loam mix'd with ſome *viſcous* Liquid, and therefore more binding than Sand.

Clay mix'd with *Oily* Parts, and therefore more binding than Loam.

And I the rather believe this, becauſe *Water* eaſily penetrates the *Loam*, and the viſcous Parts in it may be waſhed away without Difficulty; but *Clay* is more ſtubborn, and reſiſts the *Water*; which ſeems to demonſtrate that the Parts it is compoſed of, are bound together by ſomewhat oleaginous.

Chalk I take to be a certain Degree of *Clay*, whoſe Parts are more ripened; and *Marle* to be ſome undigeſted Matter, which Length of Years would ripen and conſolidate.

I obſerve that neither *Earths* or *Minerals* are always conſtant, with regard to the Depth and Situation of their *Strata*, as we may ſee in ſeveral Relations ſent to the *Royal Society* by ſome of their ingenious and learned Members. In *Phil. Tranſ.* N° 336, Mr. *Fettyplace Bellers* gives us the following Account of the *Strata* of *Earth*, *Stone*, &c. found in a *Coal-Pit* at the Weſt End of *Dudley* in *Staffordſhire*.

The 1*ſt Stratum* immediately under the *Turf*, a Yellowiſh-*Clay*, 4 Feet thick.

2*d*, A Blueiſh-*Clay*, 5 Feet thick.

3*d*, A Blueiſh hard *Clay*, called *Chinch* by Miners; it is one of the certain Signs of *Coal*. This *Stratum* is 24 Feet thick.

4*th*, A Blueiſh ſoft *Clay*, 9 Feet thick.

5*th*, A fine-grained *Grey-Stone*, which is found in ſome Pits only, 4 Feet.

6*th*, A *Clay* almoſt like the firſt, but whiter, 21 Feet.

7*th*, A hard *Grey Rock*, 75 Feet.

8*th*, A *Blue Chinch*, like N° 3, 5 Feet.

9*th*, A Black Subſtance, called the *Dun Row Batt*, 1 Foot.

10*th*, *Coal*, called *Bench-Coal*, 3 Feet.

11*th*, *Coal*, called *Slipper-Coal*, leſs black and ſhining than the former, 3 Feet.

12*th*, *Coal*, called *Spin-Coal*, more black and ſhining, 4 Feet.

13*th*, A *Coal*, by the Miners called *Stone-Coal*, like *Canal-Coal*, 4 Feet.

N. B. *Theſe* Strata of Coal, have, between each of them, *a* Batt *as thick as a* Crown-Piece.

14*th*, A Black Subſtance, called *Dun Row Batt*, the ſame with N° 9, *one* Foot.

15*th*, A hard *Grey* Iron-Ore, called *Dun Row Iron Stone*, 1 Inch thick.

16*th*, A Blueiſh Batt, (in which lies the following Iron Stone) called the *White Row*, 3 Inches.

17*th*, A hard Blackiſh Iron-Ore, lying in ſmall Nodules, having between them a *white* Subſtance, and therefore called by the Miners, *White Row Grains*, or *Iron Stone*, 1 Foot 3 Inches.

18*th*, A hard Grey Iron-Ore, with ſome *White* Spots in it, called the *Midrow Grains*, 2 Inches.

19*th*, A Black fiſſile Subſtance, called *Gublin Batt*, 2 Foot.

20*th*, A hard *Blackiſh* Iron-Ore, with *White* Spots in it, called the *Gublin Iron Stone*, 9 Inches,

21*ſt*, A *Batt*, in Subſtance much like that in N° 19, *one* Foot 6 Inches.

22*d*, A hard Grey *Iron*-Ore, called *Cannoc*, or *annoc Iron Stone*, 6 Inches.

23*d*, A *Batt* ſomewhat harder than N° 21; *one* Foot.

24*th*, A *dark Grey* hard *Iron*-Ore, called *Rubble Iron Stone*, 6 Inches.

25*th*, The *Table-Batt*, next under the Rubble Iron-Stone, 2 Feet.

26*th*, A coarſe *Coal*, called *Foot-Coal*, 1 Foot.

27*th*, A Black brittle ſhining *Batt*, 6 Feet.

28*th*, The Heathen *Coal*, 6 Feet.

29*th*, A Subſtance like Coarſe *Coal*, by the Miners call'd a *Batt*, 1 Inch.

30*th*, The Bench-*Coal*, 2 Feet.

31*ſt*, A *Batt*, 6 Inches thick.

This is as low as they generally dig, tho' there is a *Coarſe Coal* under this. We are to remark, that thoſe Subſtances which divide the *Strata* of *Coals* and *Iron-Ores*, are called *Batts* by the Miners; they are generally black, conſiſting of a Matter peculiar to themſelves, and are of a Texture neareſt like *Marle*, tho' ſome of them are fiſſile, and others have a Subſtance not unlike *Coal*, mix'd with them. It appears from hence that this *Coal-Mine* is 188 Feet ½ deep.

The other Account is of the *Strata* obſerved in the *Coal-Mines* of *Mendip* in *Somerſetſhire*, and communicated to the *Royal Society* by Dr. *Welſted*, in a Letter to him from *John Strachey*, Eſq; and inſerted in *Phil. Tranſ.* N° 360, in which we may obſerve that the Situation of the *Strata* are very different from thoſe in the *Coal-Mine* at *Dudley* above-mentioned. " We find in the digging for *Coal* " about *Mendip*, ſays our *Author*, the Surface " is moſtly a *red* Soil, which under the *firſt* " or *ſecond* Spit, degenerates into *Malm* or " *Loam*, and often yields a Rock of reddiſh " *Fireſtone*, till you come to 4, 5, or many " Times 12 or 14 Fathom deep, when by " Degrees it changeth to a *grey*, then to a *dark*

“ or *blackiſh* Rock, which they call the *Coal-Clives*;
“ theſe always lie ſhelving and regular
“ as the *Coal* doth: But in theſe Parts they
“ never meet with *Fireſtone* over the *Coal*, as
“ at *Newcaſtle* and in *Staffordſhire*; theſe *Clives*
“ vary much in Hardneſs, in ſome Places being
“ little harder than *Malm* or *Loam*, in others
“ ſo hard, that they are forced to ſplit
“ them with Gunpowder; ſo likewiſe in Colour,
“ the Top inclining to *red* or *grey*, but
“ the nearer to *Coal* the blacker they grow;
“ and where-ever they meet with them, they
“ are ſure to find *Coal* under them. The firſt
“ or uppermoſt *Coal-Vein* at *Sutton* is called
“ the *Stinking Vein*; it is hard *Coal* for Mechanic
“ Uſes, but of a ſulphureous Smell. About
“ 5 Fathom and ½ (ſeldom more than 7
“ Fathom) under this, lies another Vein, which
“ (from certain Lumps of Stone mixed with it,
“ like a *Caput Mortuum* not inflamaeble) called
“ *Cat's-head*, they call the *Cat-head Vein*. About
“ the ſame Depth again under this lies
“ the *Three-Coal-Vein*, ſo called becauſe it is
“ divided into *three* different *Coals*: Between
“ the *firſt* and *ſecond* Coal, is a Stone of a
“ Foot, in ſome Places 2 Feet thick; but the
“ middle and *third* Coal ſeemed placed looſe
“ on each other, without any Separation of
“ different Matter.

“ Next under the *Three-Coal-Veins*, is the
“ *Peaw-Vein*, ſo called, becauſe the *Coal* is
“ figured with *Eyes* reſembling a *Peacock*'s

“ Tail, gilt with Gold, which Bird in this
“ Country is called a *Peaw.* The Cliff over
“ this Vein is variegated with *Cockle*-Shells
“ and *Fern*-Branches, and is always an Indication
“ of this Vein; and under this again
“ between 5 and 6 Fathom lies the *Smith's-Coal-Vein*,
“ about a Yard thick, and near the
“ ſame Depth; under that the *Shelly-Vein*;
“ and below that a Vein of 10 Inches thick,
“ which being little valued, has not been
“ wrought to any Purpoſe. Some ſay there
“ is alſo another under the laſt, but that has
“ not been proved within Man's Memory.
“ At *Faringdon*, which lies 4 Miles diſtant
“ from the Mines of *Sutton*, the *Strata* agree
“ in all Parts.

“ Between *Faringdon* and *High-Littleton*
“ the ſame Veins ſeem to retain their regular
“ Courſe; but at *Littleton* their loweſt Vein is
“ the beſt *Coal*, which at *Faringdon* proves
“ ſmall.

“ The ſame Veins are found again in the
“ Pariſh of *Stanton-Drew*, a Mile diſtant from
“ *Sutton*, only at *Stanton* they have little of
“ the *Red-Earth*, or *Malm*, on the Surface,
“ but come immediately to an *Iron* Grit, or
“ *grey* Tile-ſtone, which is a Fore-runner of
“ the *Coal* Clives.

“ Now as *Coal* is here generally dug in the
“ Valleys, ſo the Hills ſeem alſo to obſerve a
“ regular Courſe in the *Strata* of *Stone* and
“ *Earth* found in their Bowels; for in theſe

" Hills (I mean thoſe that are diſpers'd between " the Coal Works above-mentioned) we find " on the Summits a *Stony Arable* mixed with " a ſpungy yellowiſh Clay; under which are " Quarries of *Lyas*, in ſeveral Beds, to about " 8 or 10 Feet deep; and 6 Feet under that, " thro' yellowiſh *Loam*, you have a blue Clay " inclining to Marle, which is about a Yard " thick; beneath this is a Yard of whitiſh " Loam, and then a deep-blue Marle, ſoft, " fat, and ſoapy, 6 Feet thick, only at about " 2 Feet thick it is parted by a *Marchaſite*, " about 6 Inches thick: It is to be noted that " theſe Beds of *Stone* and Marle run horizon- " tal, whereas the *Strata* of *Coal* run ſlope- " wiſe." This is very well repreſented in a Copper-Cut, (prefixed to this *Tranſaction*) which I refer my Reader to, as well as the other curious Parts of this Letter; which tho' they are not immediately uſeful to my preſent Deſign, are nevertheleſs very well worth any one's while to read.

From theſe Two Accounts, without enumerating the ſeveral Relations we might have recourſe to, we may ſatisfy ourſelves, that the ſeveral *Strata* of *Earths* and *Minerals* in *Coal-Mines*, found in ſeveral Parts, even of *Britain*, are not always conſtant and agreeable one to another; and undoubtedly, when we dig for *Tin*, *Lead*, or *Copper*, the *Strata* found in thoſe Mines do not lie regularly the ſame in one County that they do in another: And even the hardeſt of them, at this Day, were once no more than thin *Mud*, little denſer than *Water*; ſo that Bodies of no more Weight than *Shells*, or *Teeth* of *Fiſhes*, would ſubſide themſelves down to the Bottom, or lodge themſelves in it: We have Inſtances enough to prove this from the many kinds of *Shells*, *Fiſh-bones*, *Bits* of *Plants* and *Animals* found even in Bodies as hard as Marble, and almoſt every Quarry of Stone; which *Shells*, &c. could never have been there, if the Marble and other Stones they are found in had always been of the ſame Hardneſs.

But there remains a great Difficulty to determine, (*i. e.*) the Length of Time neceſſary to ripen each reſpective kind of *Mud*, ſo as to bring it to the Hardneſs of Marble, Freeſtone, Fireſtone, *&c.* But if we examine the Account ſent to the *Royal Society*, 1721, of a live *Toad* that was cut out of the Middle of a Block of hard Stone, we may reaſonably imagine, that Sort of *Stone* could not be longer than 100 Years from its State of *Mud*, to the Time it was taken out of the Quarry, without we ſuppoſe that a *Toad* can live longer. We have indeed an Inſtance of the ſpeedy Conſolidation of *Sand*, *Lime*, and *Water* made into a *Mud* or *Mortar*; and whether there may not be found ſome kind of *Liquid* to mix with *Sand* and *Lime*, which will make them more binding, and expedite their hardening, I leave Architects to conſider; but they muſt take this

Thought along with them, that even ſome *Waters* are more petrifying than others; and that ſome kinds of *Stone* lying near the Surface, are very hard when they are dug, but decay in a few Years when they are expoſed to the Air; while others, which are *ſofter* in the Quarry, grow *hard*, and *firm*, preſently after they are taken out of it.

Dr. *Stukely*, F. R. S. has very judiciouſly given his Opinion of this matter, in a Letter to the Royal Society, (*Phil. Tranſ.* N° 360.) concerning the Impreſſion of a Skeleton of a large Animal in a very hard Stone, called a *blue Clay Stone*, ſuppoſed to be dug out of the Quarries near *Fulbeck*. That Gentleman gives us, among other curious Remarks, the following Article: "Sir *Iſaac Newton*'s Doctrine of the Attraction of the Particles of Matter, according to "the Quantity of its Solidity, Proximity, and "Surface, eſpecially that it is infinitely greater "in the Point of Contact, upon which depends its Coheſion, and all the Varieties of "Phyſical Action, will eaſily direct us to a "Notion of Petrifaction. We learn how a "proper Degree of Heat or Cold, Moiſture, "Motion, Reſt and Time, promote this Principle, from the common Experiments of "Chryſtallization, and Freezing even before the "Fire, and in many Chymical Mixtures. "Whence we cannot be ignorant of *Stone* "growing in the Quarries gradually, not by "any fancied Vegetation, though there is ſome-

" thing like it in *Corals*, but generally by Ap-
" poſition of Parts to Parts, as is notorious in
" the *Fluors* of ſubterraneous Grots and Ca-
" verns; ſo that we have no reaſon to doubt,
" but what was *Clay*, *Sand*, or *Earth*, 3000
" Years ago, may now be *Stone* or *Marble*, ac-
" cording to the Proportion of Concurrence of
" ſuch mentioned Cauſes."

In the foregoing Accounts of the *Strata* we find ſome Veins, here and there, of *Metallic* Matter, as *Iron Oar*, for Example: Now, whether at the retreating of the *Waters* to their appointed Bounds after the Deluge, theſe *Metallic* Bodies were equal in Quantity and Perfection, as we find them now-a-days, is a *Query* worth examining: Or whether from a few Particles or Seeds of *Metallic* Bodies falling into a proper *Nidus*, they increaſed or enlarged: Or elſe, we may conjecture, that Parts of different Forms happening to mix with one another, agreeable to ſome Law of Nature, might with, or without the Aſſiſtance of ſome proper Liquid, frame a Body, which Length of Time ſhould ripen into a *Metal*; this, I think, deſerves our Conſideration. For my own part, I ſuppoſe that all the *Metals* now reſiding in the Bowels of the *Earth*, were not always ſubſiſting in the State they are now in; I imagine they are abundantly increaſed ſince they were firſt created, by means of *Seeds*, or ſome Method of *Generating*; and this, I think, is not more remote from Reaſon, than once the *Generation* of *Plants* was thought to be: And even from the firſt Principle of the

Production of *Metallic* Bodies, to their moſt perfect State, I imagine they undergo various Alterations, and have different Degrees of Ripeneſs, ſomewhat analogous to the Changes in *Inſectal-Bodies*; as for *Example*, Let us take out of 20 ſeveral Mines of *one* ſort of *Metal*, which will yield *Silver*, an equal Quantity of *Oar*, and refine every Parcel of that *Oar* diſtinctly, we ſhall hardly find *two* of theſe Mines produce the ſame Proportion of *Silver*, or contain the ſame Richneſs *one* as the *other*; which I ſuppoſe happens, becauſe *one* is in a riper State than the *other*; perhaps that which is now *Silver*, was *Lead*, or ſome other *Metal*, 1000 years ago. We may add to this *another* Queſtion: Whether a *Metal* once *generated* in the Bowels of the *Earth* may not be helped in its Growth, or nouriſhed more or leſs, by means of Juices (mixing with it) filtering through the *Strata* above it of various Textures and Depths? For I ſuppoſe, as the ſeveral neighbouring *Strata* of *Earths* or *Stone* are variouſly compoſed, or placed about the Vein of *Metallic* Matter, ſo the Juices or Liquids filtering through them, are of different Qualities, either nouriſhing to the *Oar* when they mix with it, or deſtructive to it: And I the rather embrace this Opinion, becauſe it does not ſeem diſagreeable to what the learned Dr. *Woodward*, F. R. S. has laid down in his Celebrated *Natural Hiſtory of the Earth*.

I ſuppoſe likewiſe, that *Gems*, which are found in the Intervals or Cavities of the ſeveral *Strata*, proceed from certain *Seeds*, or fecundating *Particles*, of their reſpective kinds, which mixing with the Liquids continually filtering through the Pores of the ſeveral *Strata*, are by Degrees brought into their Beds, (*i. e.*) thoſe Intervals amongſt the *Strata*, and are there chryſtallized, and, I ſuppoſe, grow larger as they receive additional Increaſe from the *Corpuſcules*, which continually are conveyed by the *Water* into them, and become more ripe or perfect, as they have a longer Share of Time to lie there undiſturbed. From the Experiment abovementioned, made on the *Emerald* with Mr. *Villette*'s Burning-Glaſs, whereby it was changed into a Subſtance like a *Turky-Stone*, and the other Obſervation there mentioned, we might alſo conjecture, that every particular Kind of *Gem* requires a different Degree of Heat or Cold to bring it to its true Conſiſtency and Colour; and then we may ſuppoſe, that while any *Gem* is *firſt* forming, and conſequently in a *tender* State, that then a little Difference from the Degree of Heat or Cold it naturally required, would alter its Qualities: But Nature ſeems to have a ſpecial Regard to maintain them always in the ſame Degree, without Alteration, by placing them in the *Bowels* of the *Earth*, where (if I may ſo ſay) they always *breathe* the ſame conſtant *Air* without Interruption.

As for *Pebbles*, *Flints*, and ſuch like *Stones*, Dr. *Woodward* ſuppoſes them to have been all originally formed and repoſed in the *Strata* of *Earth* and *Sand*; and even the *Amber* too, which that curious Gentleman makes a natural *Foſſile*, as well as the reſt; and the Reaſon he gives why we find ſo many of them looſe on the *Sea-Shores*, and on the *Surface* of the *Earth*, is, "that by violent Waſhings of Rains, and " by the *Sea* or other *Water* beating upon " the *Shores*, *Cliffs* or *Lands*, the *Earthy-Parts* " are diſſolved and carried away; but the " *Pebbles*, *Pyritæ*, *Amber*, or other like *Nodules*, being hard, and not diſſoluble, and more " bulky and ponderous, are left behind, di" veſted of their terreſtrial Covering." And indeed I do not find the Growth or Increaſe of ſuch-like Bodies can be accounted for any other Way, than by ſuppoſing them to have had their firſt Being in the Bowels of the Earth, where they might be regularly ſupplied with every thing neceſſary for their Conſtruction and Nouriſhment; and again, it is ſo much more obvious, as we find every ſort we can name, as well lying in *Strata* under Ground, as expoſed upon the Shores and Surface of the Earth. And the Nouriſhment and Difference of Colours given theſe Bodies, while they were lying and growing in their ſeveral *Strata*, I ſuppoſe to be produced by a Cauſe, nearly the ſame of that which gives us the different Colours in the Leaves and Flowers of Vegetables; the ſeveral Strainers or Veſſels which compoſe Plants, doing perhaps the ſame Office that the ſeveral

Strata of *Earths* do to *Minerals* or *Metals*; and as the different Juices paſſing through the ſeveral Veins or Beds of Earth are altered by a ſort of Filtration, and varied by mixing with ſome Mineral-Corpuſcules, which would be latent without ſuch Aſſiſtance; ſo theſe Juices differently ſtrained through the ſeveral Kinds of Earth, mixing with ſome Vegetable Particles, which change their Qualities, produce Difference of Colours in the Leaves and Flowers of the Plants they paſs through.

And this is what I ſhall venture to mention at preſent concerning *Earths* and *Mineral* Bodies, which, if my Conjectures are right, have a kind of *Growth*, and even a Mode of *Generating* and *Increaſing*; and if once we have ſufficient Proof of theſe, we need not ſcruple to allow them *Life* too, however ſlow it be: Theſe indeed have no *Local Motion* any more than Plants; but *Animals* that have *Local Motion* are yet analogous to *Plants* in *Generation* and *Circulation* of Juices through their Bodies, and have *Senſation* more than *Plants*: *Plants* then want *Local Motion* and *Senſation* to be equal to *Animals*; but I ſuppoſe have only the Powers of *Viſible Growth* more than *Minerals*, and of being *tranſplanted* from *Place* to *Place*, and yet retain the Power of *Growth*; but where muſt we *tranſplant* the *Earth* to make it grow, or improve it?

CHAP. II.

Of the CORALINE, TRUFFLE, FUNGUS, SPONGE, *and ſuch Bodies which poſſeſs the firſt Degree of* Vegetative Life, *and are ſeemingly the Paſſage between* Minerals *and perfect* Plants.

HAVING taken Notice (as far as my Experience will permit) of *Minerals* and *Metallic* Bodies, that they poſſeſs a certain Share of *Life*, or Kind of *Growth*, whereby they attain to diſtinct Degrees of Perfection, as they have lain *more* or *leſs* Time in their *natural Beds*; the *Stones* which I have in the laſt Place taken notice of, have each, according to its Tribe, a Figure or Form, which diſtinguiſhes it from *one* of *another* Claſs; and the Length of Time which Nature takes to form them, gives them at leaſt an equal Share of Time to remain unperiſhable; ſo it is likewiſe obſervable in *Vegetables*, that as they are more *ſlow* of *Growth*, ſo is their *Remain* of longer Duration; but I conceive there is not in Nature any *Vegetable Body* which can have, or ever had, half the Durance of *Minerals*, unleſs *Coral* may be allowed its Place among *Vegetables*: And it is the different Sentiments of our great Men concerning this Subject, which puts me to ſome Difficulty in this Part of my Work. It is not allowed by ſome to be more than a *Petrified Body*, while ſome Gentlemen of the Royal Academy at *Paris* pretend to have diſcovered its *Seed Veſſels*, as we may find in the Memoirs for the Year 1711. For my own Part, I will not pretend to determine ſo great a Difficulty, unleſs I had more Experience in the Matter. I ſhall only take Notice from its branched Figure, and its Manner of faſtening itſelf to *Rocks*, *Stones*, and *Shells*, that it has ſome Analogy to *Plants*; for in the firſt Place, if we conſider the *Coralines* frequently growing upon our *Engliſh* Coaſts, the Manner of their rooting in *Stones* and upon *Oyſter-Shells*, their Method of branching, and cruſted Subſtance, I cannot ſee any Reaſon why we may not place *Coral* amongſt the *Submraine-Plants.* Again, as to the rooting of *Coral* in this Manner, and the Poſſibility of its drawing Nouriſhment from Bodies of ſo hard a Nature, let us look upon the *Sea-Belts*, which ſometimes are of that Length and Extent, that I have meaſured ſeveral above 6 Feet long, though the Stones they were rooted in, did not weigh above a Pound a-piece: So likewiſe the *Sea-Weeds*, and *Fuci*, have not always larger Bodies to draw their Nouriſhment from; but indeed they may probably be aſſiſted in their *Vegetation* by the frequent Returns of the *Sea-Water*, which may ſerve to fill their more ſpungy Parts, and contribute to make them ſwell, as the circumambient Air aſſiſts the Growth of *Land-Plants*. Moreover, we find that *Coral* is of different Kinds or Species, as much as any Plant growing upon the Land; we have the *Red*, the *White*, and the *Black*, pretty common, beſides many other more rare Sorts in the Cabinets of the Curious, where I commonly find them accompanied with *Coralines*, the *Sea-Fan*, and other ſuch-like Bodies.

The famous Cabinet of Mr. *Vincent* at *Haerlem* abounds in theſe Rarities; as does alſo that of the curious Dr. *Frederick Ruyſh* of *Amſterdam*, where I have ſeen near 60 Sorts remarkably different from each other. Eſpecially in the *firſt* curious Collection is to be admired a large Branch of the *Red-Coral*, above 1 Foot $\frac{1}{2}$ in Height, of an extraordinary Value. There is indeed one Thing which we may take notice of, with regard to *Coral*, that upon breaking off any Part of a Branch, we diſcover the ſame Star-like Shootings as are found in the *Star-Stones*; and there is ſeemingly wanting thoſe capillary Veſſels which run longitudinally, to convey the *Sap* up the *Stems* of *Plants*; nor do I find by Enquiry, with my beſt Microſcopes, that they have any, which is much the ſame Caſe with the Leaves of the *Aloe*, and ſome other Kinds of *Succulent-Plants*, where we cannot diſcover any Veſſels which run longitudinally through them, and are therefore brittle as Glaſs. The famous Mr. *Lewenhoeck* of *Delft*, who was juſtly reckoned the greateſt Man in *Europe* for his Skill in Microſcopes, has given the World a curious Account of his Obſervations on *Red-Coral*, in a Letter to the Royal Society, wherein, I think, are ſeveral Remarks which may greatly contribute to illuſtrate this Point, and help to determine whether it is more a *Mineral* or a *Vegetable*. He tells us " that he has ſeen ſmall Parts " of the *Red-Coral* upon a little *Scollop-Shell*, " and upon a ſmall Fiſh called a *Horn*, and " was of Opinion that it did not grow on thoſe " Bodies, but was only coagulated upon the " ſaid *Shells*. He then proceeds to give us an " Account of his microſcopal Obſervations, and " tells us that he cut off ſeveral thin ſcaly " Particles, both longitudinally and horizon- " tally, from the Blood-Coral, in order to diſ- " cover the Veſſels in them: He obſerves, that " in thoſe Parts which he had cut through a- " croſs, there ran ſuch Fibres from the Center to " the Circumference, as are found in the Roots " of under-ground Fruits; but that in the other " Parts he had only a faint View of ſome ve- " ry ſmall Orifices of Veſſels, and could make " no perfect Remarks of them, but that it " ſeemed to him as if the Parts of *Coral* were " made up of roundiſh Particles, ſuch as ſome " certain Fruits are compoſed of; but their " Roundneſs was not exactly equal *one* to the " *other*, but ſuch as might beſt ſuit with the " reſt, ſo as to leave Vacuity in them; *(I ſup-* " *poſe like the Bubbles in Froth of Liquors)* " and thus, ſays he, the *Saps* which are not " in the *Veſſels*, are conveyed from one of " thoſe round Parts to the other, and ſo ſerve " for *Canals*."

Again, he ſuppoſes that "*Coral*, whilſt it
" was growing at the Bottom of the *Sea*, is
" very ſoft, and that the *Plants* of *Coral*, or
" their *Branches* being broken off by the *Coral*
" Fiſhers, the thick Ends of them may acci-
" dentally fall upon a *Stone* or ſome other Sub-
" ſtance; and by reaſon of their Softneſs, and
" a glutinous Matter they are indued with,
" may very eaſily be faſtened to the *Stone*, and
" then give us Reaſon to believe it is an Ex-
" creſcence from the *Stone*, or other Subſtance
" we find it upon."

From this *laſt* Obſervation, as well as the *former*, I do not ſee any Reaſon why we may not place *Coral* among *Vegetables*; for as I have remarked before, that the Brittleneſs of *Coral* may proceed from the ſame Cauſe as that does in the Leaves of *Succulent* Plants (*i. e.*) the Want of longitudinal Veſſels, ſo may the *Coral* partake of other Properties common to *Succulent* Plants, ſuch as that if we only lay upon the *Earth* an Off-ſet or Branch of *Aloe* or *Sedum*, they will ſtrike Root in due Time without other Trouble; and Shells and ſtony Subſtances being to the *Coral*, as the *Earth* is to the above-mentioned *Plants*, a broken Piece may as well take Root upon *them*, as the others do upon the *Earth*.

The *Sponge* is the next which we may conſider as a Subject leading to *Vegetation*, and is (what I believe is allowed by all to be) a *Plant*, though it is indeed ſeemingly imperfect, if we compare it with others; but its Veſſels are ſo nicely woven into one another, that every Part is equally ſupplied with Juices as it flits, or is driven from Place to Place upon the *Sea*; it is a Wanderer as well as the *Lens Paluſtris*, or *Duck-Meat*, which ſeldom or never fixes its Roots in any ſolid Body, but ſtrikes them into the *Water* only, from whence it receives its Nouriſhment. The Figure of the *Sponge* is for the moſt Part globular, but without any great Exactneſs; it is compoſed of Parts rather like the *Pith*, than any other Part of a Plant, is wanting of Leaves, and has not either Flowers or Fruit that I can yet diſcover. There are relating to the *Sponge* ſeveral Kinds of *Spongoids*, which are ramoſe or branched; but the Texture of their Parts are near the ſame with the common *Sponge*.

The next following theſe, and but little more perfect, ſeemingly, either in Figure or Parts, is the *Truffle* and the *Puff-Balls*. The *Truffle* is of *two* Kinds, as Mr. *Tournefort* informs us, the one *round*, the other *oval*; but the fleſhy Part of both theſe Kinds is of a much cloſer Texture than the *Sponge*, and each of them grow commonly about 6 Inches under Ground in the Woods of *Italy*, *France*, and ſeveral Parts of *England*, and I am informed have their *Seed-Veſſels* towards the Center, in the moſt fleſhy Parts; but as yet I have not been able to diſcover any, but refer my Reader to the Account given of this Tribe of *Plants*, by the curious Mr. *Geoffroy*, in the *Memoirs of the Royal Academy of* Paris, for 1711. I am apt to believe the *Truffle* is not unlike the *Puff-Ball*, as to its Manner of *Growth*; that is, in the firſt Place its Fleſh is pretty firm, and by Degrees, as it becomes more ripe, its Inner-Parts change to a Kind of *Duſt*, as we find in the *Puff-Balls*, which grow ſo plentifully upon Commons and other Paſture-Grounds, whoſe *Duſt* I ſhould rather ſuppoſe to be the *Seed*, than be inclined to look for it in them while they are in their growing State. Of the *Puff-Balls* I have likewiſe obſerved *one* ſort growing in the Shape of a *Pear*, commonly under *Crab-Trees*.

After theſe we muſt take notice of thoſe of the *Fungus Tribe*, which are yet without Caps, but ſeeming more conſtant and regular in their Figure than thoſe already-mentioned. There are *two* Kinds which reſemble Branches of *Coral*; they are common in *Moſſy-Grounds* in *England*, and differ only in the Colours of *yellow* and *white*. After them the *Cap Muſhrooms* cut on one Side, ſuch as the *Fungus Sambucinus*, or that which is found growing about the Roots of the *Alder-Tree*, and ſome others nearly allied to it, which are of an *Orange* Colour.

Next are thoſe Kinds of *Fungi* with *Stems* and *Caps*, which vary their Figures as they become more replete with Juices; theſe begin to ſhew us ſome Parts, which we may naturally expect to find in *perfect Plants*, as *Roots* and *Veſſels*, which run longitudinally, and compoſe the *Stem*, from whence the *Cap* receives its Nouriſhment till it is fully explained, as may be eaſily diſcovered in the common *Muſhroom* or *Champignon*, without the Help of a Glaſs, as well at its firſt Appearance in the *Button*, as when its *Cap* is fully ſpread: The *Chives* within-ſide of the *Cap* have been by ſome taken for the *Seed*; but I do not find, with the greateſt Care, they can ever be made to *germinate*.

As to the *Champignon*, which is ſo much eſteemed for its excellent Flavour and delicious Reliſh, it is propagated with great Facility in the Gardens about *Paris*; but the Gardeners there, have no regard to the *Chives* which I have before-mentioned; nor do they believe there is any ſuch Thing properly as *Muſhroom-Seed*, but chiefly rely upon the Manner of making Beds for them, and placing here and there, in thoſe, Beds ſmall Pieces of *Moldy-Soil*, found commonly in old Dunghills, which is accounted better, as it abounds with *White*, Cobweb-like, *Veins*, running through it. And it is obſervable that the *Moldy-Soil* I mention, after lying 3 or 4 Days in the Bed, becomes as it were a Leaven to the Whole, by ſhooting out its Cobwebs over the greateſt Part of the Surface, and at length runs into Cluſters of ſmall *White*-Knots, which come in the End to be perfect *Muſhrooms*. To make theſe Beds, they provide three or four Cart-loads of Horſe-dung, well cleared from the Straw, and toſs it up in an Heap to lie for 15 Days; then they mark out their Bed 3 Feet wide, and of that Length as may employ the Dung to lie near a Foot ½ thick, laying the Sides ſloping in ſuch a Manner, as that the Top of the Bed may be brought to a Point or ſharp Edge, like the Ridge of a Houſe, when it comes to be raiſed 3 Feet high; which muſt be done with Dung, prepared, as before, 15 Days after the firſt making or laying of the Bed.

Immediately after the *firſt* Layer of Dung is wrought, it muſt be covered, the Top and Sides, with Horſe-litter to lie upon it undiſturbed, till we lay on the *ſecond* or laſt Courſe of Dung, and then the whole Bed muſt be coated an Inch think, with fine Earth, and beat down gently with a Spade, having a ſtrict regard where the Line runs between the *two* different Layers of Dung, along which there muſt be buried about an Inch deep ſome ſmall Pieces of the Moldy-Soil as big as *Wallnuts*, at a Foot Diſtance, and then the whole carefully covered with Horſe-litter: From this Management we may expect a large Quantity of *Muſhrooms* in a Fortnight after the Bed is completed, and will continue to produce every Day for a Month or five Weeks.

In the gathering of this Dainty, the *French* Gardiners always take care to pull them up with their Roots, preſſing the Earth down gently upon the Place they draw the *Muſhrooms* from, and covering it with the Litter immediately; they are likewiſe very curious to obſerve, that no broken Part of a *Muſhroom* be left on the Bed, which would breed Worms, and deſtroy the young Knots of *Buttons*, which are coming forward. In the Winter they lay up great Parcels of the Moldy-Soil in dry Places, for their Uſe at different Times; and they have this regard to the making of their Beds in the Summer, that from *May* till *September* they lay the Foundations of them 8 or 10 Inches below the Surface of the Earth.

Of theſe *Cap Muſhrooms* there are ſome more ſubſtantial, others more fugacious, ſome edible, others poiſonous; but to take them together, they are a very numerous Family. The curious Mr. *Dandridge* (to whom I have been obliged for many Notes and Obſervations mentioned in this Work) has now by him the Paintings or Figures of above 100 Sorts, which he has collected in *England*; and I am perſuaded that there is hardly any Nation which does not afford as many different Kinds in Proportion, conſidering the Drawings I have ſeen in the curious Cabinets Abroad. The Times of their natural Growth, are in the Spring, and Autumn.

We may note, that the Moldineſs upon Liquors, and ſuch as appears upon Confections and Pickles that are damaged, is of this Tribe: They are Multitudes of ſmall *Fungi* or *Muſhrooms*,

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Plate II

Fig. I

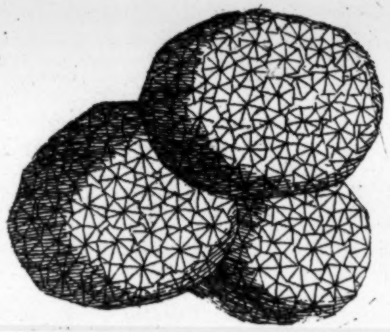


Fig. 2

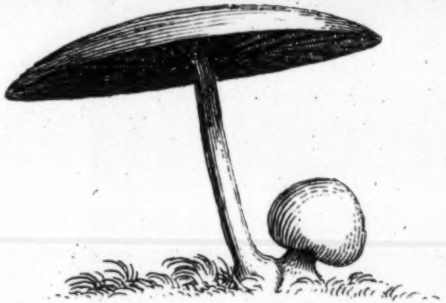


Fig. IV

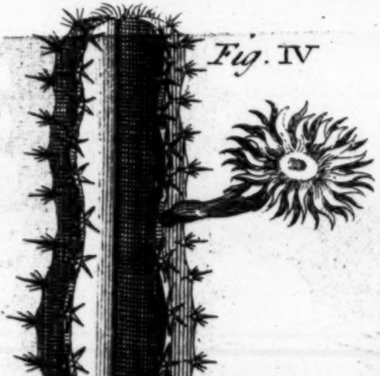


Fig. III

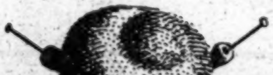
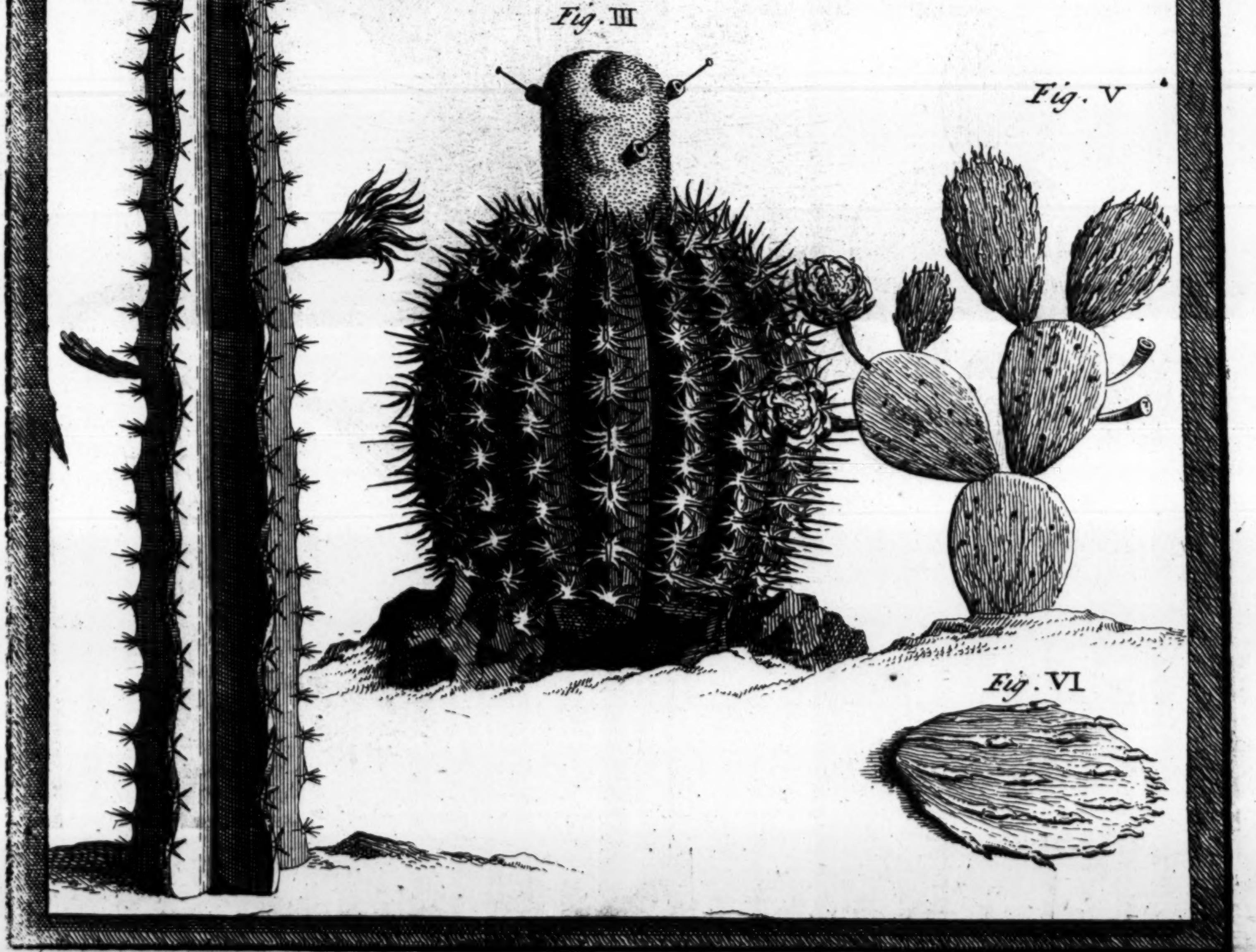


Fig. V



J. Cole Sculp

Plate. I.

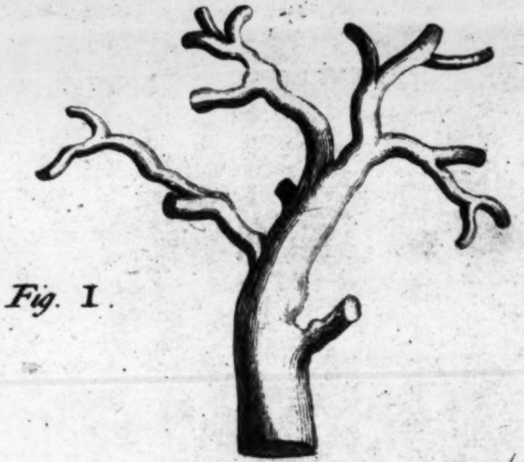
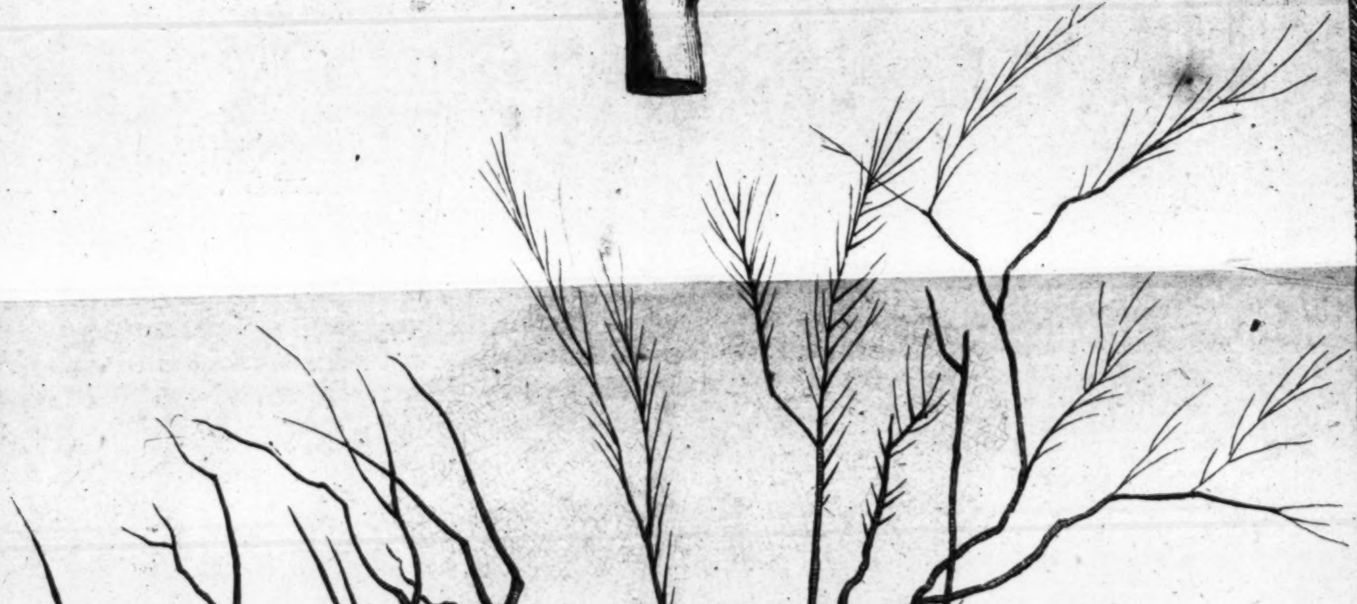


Fig. I.



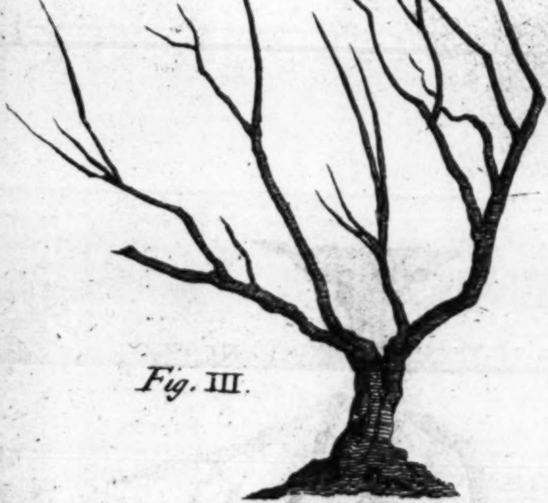


Fig. III.

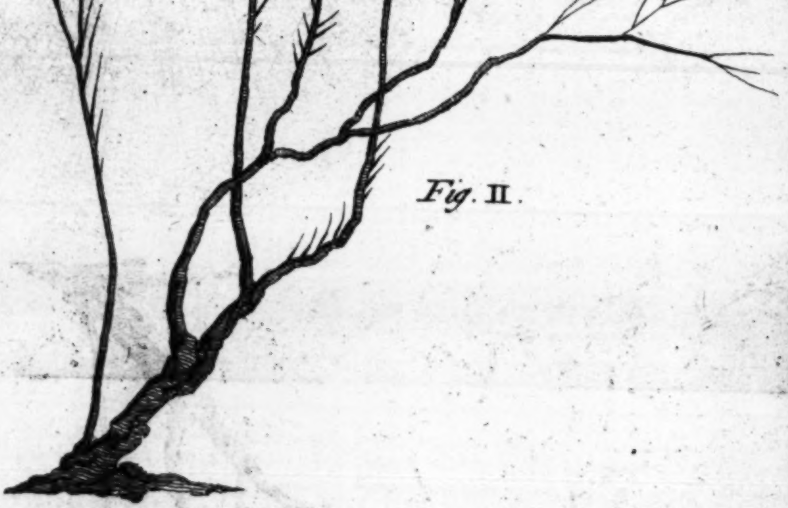


Fig. II.

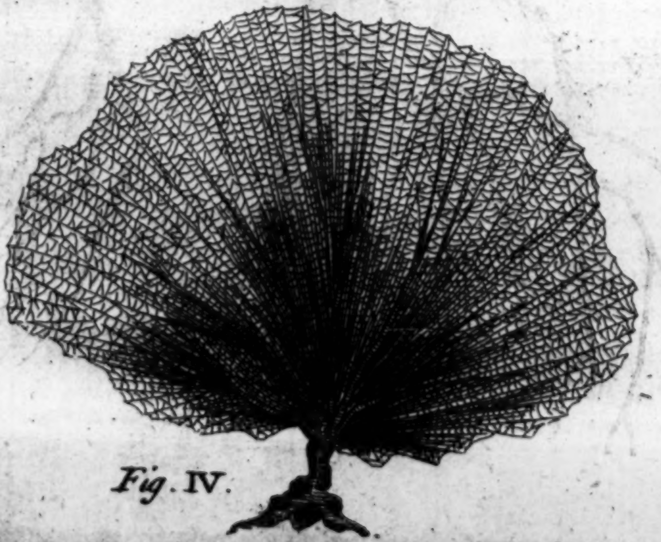


Fig. IV.

J. Cole Sculp.

rooms, which are of that quick Growth, that in about 15 Hours one ſingle Point will ſpread a quarter of an Inch over the Surface, as I have obſerv'd with a Microſcope.

Explanation of the Figures relating to Chap. II.

PLATE I. Fig. I. *A Branch of the* Red Coral.
Fig. II. and III, *Branches of* Coralines.
Fig. IV. *The* Sea-Fan.
PLATE II. Fig. I. *The* Truffle.
Fig. II. *The* Button *of the* Muſhroom, *with its Plant fully perfected.*

CHAP. III.

Of PLANTS *and* SUPER-PLANTS, *what is moſt remarkable in them.*

WE have given an Account of thoſe Vegetables which ſeem to be the moſt imperfect, as to their want of Parts; but they are indeed more ſpeedy in their Growth than thoſe *Plants* which have the uſual Ornaments of *Leaves*, *Flowers*, and *Fruit*, or ſuch as we ſhall find treated of in this Chapter. *Muſhrooms* however are certainly perfect as to themſelves; but the more common Knowledge of *Trees*, *Herbs*, and *Shrubs*, may give us room to think, that whatever Vegetable is wanting of the Ornaments theſe poſſeſs, is not perfect. For my own part, I think it no ſmall Pleaſure that Nature is ſo extenſive and variable in her Works, that a bare Diſcovery of them is more than we can attain to; and that the Mind of Man,

which

which naturally loves Novelty, has the grateful Opportunity of being placed in the midſt of ſuch a boundleſs Variety. With regard to Life and Growth, the Unskilful are apt to judge, that Parts of the *ſame Kind* muſt equally reſide in all *created Bodies*; but if I may venture to give my Opinion concerning that Caſe, it is, that whatever *Vegetable* or *Animal* is wanting of *half* the Parts or Ornaments that we find in *others*, thoſe ſeemingly *Imperfects* have a double Power of acting from every Part they contain, ſo that *two* Parts in *them* perform as much as *four* in the *others*; which may perhaps be the reaſon that *Muſhrooms* are of a quicker Growth than thoſe *Plants* which we ſtile the moſt *Perfect*.

The *Plants* which I think moſt properly follow the Tribe treated of in the foregoing Chapter, are *firſt*, The *Ruſh* Kind, or *Juncus*, of which there are many Sorts, ſome larger, others leſſer, which chiefly diſtinguiſhes one Kind from another, all of them conſiſting of green ſpiral Stems, which reſpectively bring forth Bunches of Flowers that end in *Seed*, but have no *Leaves*. They may be rather accounted *amphibious* Plants, than Inhabitants of the Waters, ſeeing that they grow as well as on the Land, if it be tolerably moiſt, as in the Waters.

Theſe may be ſucceeded by the *Echinomelocactus*, or *Melon Thiſtles*, which are *Plants* without Leaves, and are only guarded with *Thorns*.

The *Melon Thiſtles* never branch, unleſs they are cut, as I have obſerved in *two* Kinds of them: The large Sort, which comes commonly from *Nevis* and *St. Chriſtophers* in the *Weſt-Indies*, by loſing its Top, or Crown, puts forth young Heads, which may be taken off and planted for Increaſe; and ſo likewiſe the ſmaller Kind, which comes from the *Cape* of *Good Hope*, will do the ſame. The firſt of theſe I have ſeen in the State I mention in the Royal Gardens at *Hampton-Court*, and the latter in the Phyſic-Garden at *Amſterdam*, from which Place I brought ſeveral young Plants. It is remarkable, that in both theſe the Bloſſoms barely appear through the Skin or Covering of the *Plant*, and the Fruit always remains hid within the *Plants* till it is full ripe, and then burſts forth on a ſudden, which is not common in other *Plants*. Theſe *two* are deſcribed in Mr. *Ray*'s *Hiſtoria Plantarum* and in the *Hortus Lugduno-Batavus*, and are engraven in my *Hiſtory* of *Succulent Plants*.

The next, is the *Torch-Thiſtle*, a *Plant* of an extraordinary Face; it is wanting of *Leaves*, but in other Reſpects coming nearer the Perfection we look for than the former. Theſe ſhooting out their Branches freely, are all guarded with *Spines*, and bear large *Star-like Bloſſoms*, which do not open till the Fruit is full grown, after the Manner of the *Opuntia* or *Indian* Fig: The largeſt Kind of them is that which we have ſo common in our Green-Houſes in *England*, and is engraven in the *firſt* Decade of my *Hiſtory of Succulent Plants:* This I have ſeen near 20 Feet high in the Royal Garden at *Paris*; and at *Hampton-Court* there is another ſort with a *White* Rind or Skin, which, like the former, grows upright, but with leſs Luxuriancy. The *firſt* of theſe I call *Cereus erectus maximus Americanus hexangularis, Flore albo radiato*, or, *Great Upright Torch Thiſtle:* The ſecond, *Cereus Americanus octangularis Spinis albicantibus*, or, *Great White Torch Thiſtle.* At the Phyſic Garden at *Amſterdam* they have 3 or 4 different Kinds of the *Upright Cereus*, which I have not ſeen elſewhere. Of this *Tribe* there are likewiſe ſome *Creepers*, which are jointed, and run upon the Ground: Their *Thorns* are commonly ſmall and tender, and the young Shoots are for the moſt Part furniſhed with voluntary Roots, which lay hold of the *Earth*, or *Barks* of Trees, as they happen to fall. *One* ſort has a triangular *Stem*; the other has its *Stems* in 6 Ribs. The *firſt* is engraven in my *firſt* Decade of *Succulent* Plants; the *other* is in my third Decade. To theſe we may join the *Euphorbium*, and ſome other *Tythymals*, which are yet without *Leaves*; they ſhoot their *Stems* upright, are guarded with *Thorns*, and differ from the foregoing *Plants*, in having a *Milky-Juice*, and *Flowers* and *Fruit* of ſmall regard. Dr. *Comelin* has given us very good Cuts of many of them in his *Hortus Amſtelodamenſis.*

The *Plant* ſucceeding the *Euphorbium* is the *Opuntia* or *Indian* Fig, which is the firſt *Plant* that attempts to make Leaves, but in ſuch a Manner as may eaſily ſlip the Obſervation of the Curious. Mr. *Rand*, F. R. S. a moſt ingenious and learned *Botaniſt*, was the firſt who informed me of them; they appear only upon the young *Stems* whilſt they are perfecting their Growth, and afterwards are ſupplanted or followed by Knots of *Spines*. Of this *Tribe* I have ſeen about 13 Sorts growing in *England*, which I deſign to deſcribe in my *Decades* of *Succulent* Plants; they are all very full of Juice and Pulp, ſhooting *Stem* out of *Stem:* It is from one of theſe Kinds that the *Indians* gather the *Cochineal*, which I ſhall mention at large in its Place.

The *Fig-Tree* may next follow the *Opuntia*, as the Fruit is always perfected in its Parts before the *Bloſſom* is to be found. What I mention concerning the Bloſſom of the *Fig*, or Manner of its *Flowering*, I have not myſelf yet ſeen; but take the Account from my Friend Monſieur *Geoffroy*, of the Royal Academy at *Paris*, who has given a large Deſcription of the *Flowers* of it in the *Memoirs* of the *Royal Academy* of *Sciences* at *Paris*, for the Year 1712. That Gentleman, upon the Foot of what Mr. *Moreland*, *myſelf*, and ſome *others*, have advanced, concerning the *Generation* of *Plants*, or the Manner of ſetting their Fruits, has given a large Account of ſuch Parts of Bloſſoms in the *Fig* as are neceſſary in Nature to perform the *Office* of *Generation:* He tells us, that " all the Parts

“ required to do this Work are within the *Fruit* “ of the *Fig*; thoſe which are *Female* lying to-“ wards the *Bottom* of the *Fruit*, and the *A-“ pices* or *Male-Parts*, which produce the *Fa-“ rina fecundans*, are ſituate towards the *Top*.” He has given us very good Figures of them in general, and in particular, both from *Natural View*, and with the *Microſcope*, which I ſhall leave the Curious to examine; and in the mean while, as I have had Occaſion to mention ſomewhat relating to the *Generation* of *Plants*, I ſhall entertain my Reader with an Accurate Eſſay upon that Subject, which was communicated to me in the Year 1719, by that excellent Phyſician Dr. *Antoine de Juſſieu*, Profeſſor Royal of *Botany* at *Paris*, entitled,

The Analogy *between* Plants *and* Animals, *drawn from the* Difference *of their* Sexes.

THAT *Plants* and *Animals* are *analogous*, we may be convinced, if we only conſider the *Manner* whereby they receive their *Nouriſhment*. That ſort of Life, which the antient Philoſophers obſerved in Plants, was accounted by them ſo nearly the ſame with that in *Animals*, that they did not ſcruple to call it a *Soul*, but has ſince been more reaſonably termed *Vegetation*.

The Compariſon that has been made between the Structure and Uſe of the *Bark* of *Plants*, with the *Skin* of *Animals*; of the *Tubes* through which the *Sap* is conveyed through the *Trunk* to the *Extremities*, with the *Arteries* and *Veins*;

the Reſemblance of the *Ramifications* of thoſe *Channels*, which the *Blood-Veſſels* and *Lymphaticks*, has given Occaſion to *Ceſalpinus* and other illuſtrious Authors amongſt the Moderns, who have ſtudied the *Anatomy* of *Plants*, to eſtabliſh this Syſtem.

We may yet advance this Opinion much farther, if we conſider the *Nature* of *Plants*, and how they may be diſtinguiſhed as *Terreſtrials*, and *Aquatics*, and thereby agreeing with the *Animal* Kingdom. We may alſo compare the Solidity and Duration of *woody* and *vivaceous Plants*, with the Strength and Length of Life in *Quadrupeds*. We may likewiſe obſerve the Similitude between the *Capillary* and *Fungous Plants*, and the ſhort Remain of ſuch as are *Animal*, with the Imperfections attributed to *Inſects*, and the Shortneſs of their Lives: And to this we may add another Remark, That among *Plants* there are *two* ſorts of *Aquaticks*, which, like Fiſh, are either diſtinctly Inhabitants of the Salt or Freſh Waters.

As there are *Amphibious Animals*, ſo is the *Vegetable* Kingdom alſo furniſhed with *Plants* that have Parts which live as well *out*, as *within* the *Waters*.

But as theſe general Obſervations, which are founded upon the Structure of the *Organs*, and upon the Mode of *Growth*, have been already diſcuſſed by ſo many Phyſicians, that there is no room left for Doubt; I ſhall make it my Buſineſs to eſtabliſh another kind of Agreement betwixt *Plants* and *Animals*, by more particular Obſervations, drawn chiefly from the *Diverſity* of *Sexes*, and from the Conformity and Uſes of thoſe Parts which are to be diſtinguiſhed in them, for the perpetuating their *Species*.

It appears that the Antients had ſome Notion of this Diſtinction of *Sex* among ***Plants***, as we find in their Writings that ſome have given the Quality of *Male*, others of *Female*, to certain *Vegetables*; but the more I have taken Pains to examine into the Reaſons they had to eſtabliſh this *Difference* of *Sexes*, ſo much the more I find them out of Reaſon; eſpecially when I diſcover that they have given the *Feminine*-Character to ſome *Plants* for the ſake of their beautiful *Flowers*, or from the Port or Appearance of the whole *Plant*, as in the *Peony* and ſome others; or elſe they had eſtabliſhed the *Maſculine*-Gender from the Conformation of the *Roots*, *Fruits*, or *Seeds*, as they were nearer the Reſemblance of the *Male*-Parts of *Generation* in *Animals*, as in the *Orchis*, *Mercury*, *Hemp*, &c.

But the Chief among modern *Botaniſts*, *Malpighius*, *Grew*, *Ray*, and *Camerarius*, have greatly improved upon the Hints given by *Ceſalpinus*, by marking out to us in a particular Manner the *Diſtinction* of *Sexes*, in the Deſcription of certain Parts which perform thoſe Functions.

I ſhall not in this Place enter upon the late Propoſition of Meſſieurs *Geoffroy* and others, who in the Deſcription they give us of the *ſeveral* Parts of a *Flower*, tell us, that the *Duſt* which falls from the *Apices* of *Flowers*, is the *Germ* of the *Plant*, or *Embryon* of it; ſince this Syſtem is ſubject to the ſame Difficulties with that of the *Generation* of *Animals*, ſuppoſed to be affected by the *Worms* or *Animalcules* in the *Male*-Seed.

Nor do I pretend to aſſign any Reaſon why Nature has obſerved ſo much Regularity in ſo many different Figures, as we find in the *Farina* of each reſpective Kind of *Plant*, with the help of *Microſcopes*; ſince Dr. *Grew*, who was ſo careful in his Obſervations of this Nature, and Monſieur *Geoffroy*, who is a diligent Follower of our ingenious Countryman, have neither been able to find them out.

I ſhall only take upon me to compare the *Exteriors* of *Plants* with *Animals*, as far as it regards their *Sexes*, wherein this *Difference* of *Sex* in *Plants* conſiſts, and the Manner of obſerving it.

As the *Flower* is that Part of a *Plant* which contains the *Organs* for its *Generation*, it is neceſſary to determine what Idea we ought to have of it, and not to fall too haſtily into the enormous Opinions of ſome, who believed with *Malpighius*, that their moſt eſſential Parts were no more than *Viſcera* appointed for ſeparating the excrementitious Juices.

I am of Opinion, that what we ought properly to call the *Flower*, is the Aſſemblage of little Threads, to which the *Botaniſts* have given the Name of *Stamina*, and are terminated at their *Tops by ſmall Caps* or *Purſes* called *Apices* or *Chives*, which generally have double Openings, from whence flies out the fine *Duſt* which ripened in them.

The *Stamina*, which I have juſt now mentioned, are either encompaſſed by a ſingle or double Furniture, either of *one*, or of *many* Pieces, conſiſting of *one* or of *various* Colours, which have hitherto been called *Leaves*, but may rather bear the Name of *Petals*, to diſtinguiſh them from the common Leaves of *Plants*, which are generally *Green*, as well as thoſe which ſerve for an outward Coat to the *Petals*, and known by the Name of *Calyx* to the Flower.

Theſe *Stamina* encompaſs, for the moſt Part, a Body of a different Figure, either ſingle or compoſed, which is either the *Embryo* of the *Fruit*, or a *Tube* terminating like a Trumpet, to either of which the Name of *Piſtillum*, or *Piſtil*, is indifferently given.

This Deſcription I conceive is exact and full enough to give us a quite different *Idea* of the *Flower* than what we have hitherto received, and may oppoſe the vulgar Opinion, that every *Body* of *various-coloured Leaves* is a *Flower* or *Bloſſom*; inſtead of which, the curious Obſervers of Nature cannot miſs the Obſervance (beſides the *Petals*) of all the other Parts which we have juſt now mentioned; and from the inſtant they behold them, muſt of neceſſity perceive their Uſes from their Structure and Diſpoſition, but more eſpecially when they have Opportunity of obſerving their ſeveral States and Changes at different Times,

We may conclude then that the *Secret* of *Generation* is neither to be found in the *Root*, *Trunk*, or *Leaves* of a *Plant*, but only in the *Garniture* of thoſe *Organs*, which we have obſerved the *Flower* is compoſed of: Since we do not find in any other Part of *Plants* thoſe *Organs* which ſo well agree with the Parts of *Generation* in *Animals*, or are ſo uſeful and neceſſary to perpetuate their Species. It ſeems as if Nature, who has hid from us her Manner of Working in the *Generation* of *Animals*, is more inclined to open that Myſtery to us in the *Vegetable* Kingdom, ſince the Means ſhe makes uſe of, with regard to the *Generation* of *Plants*, is more open, and may be more eaſily obſerved.

In effect, what can more reſemble thoſe *Organs* which conſtitute the *Male*-Sex in *Animals*, than thoſe which characterize the ſame in *Plants*? What Agreement is in their Functions! Thoſe little *Caps* which make the *Chives* of the *Stamina*, the *Farina* which they incloſe, and is ſo exquiſitely prepared as a proper Matter for *fœcundating* the *Germ*; and again, thoſe Trumpet-like *Tubes*, which are ſtiled *Piſtils*, ſituate in the Center of the *Stamina*, for the more eaſy Reception of the *Duſt*, which is the Offſpring of the *Apices* or *Chives*; the Springs which open them, and the Manner of their flinging abroad this prolific *Duſt*: Do not theſe ſufficiently ſet forth the beautiful Simplicity that Nature obſerves in her Works?

If we could find modeſt Terms to expreſs the Care and Precaution which Nature takes to ſucceed in her Work of *Generation* in *Animals*, what Agreement and Uniformity ſhould we not find with that ſhe makes uſe of in the *Generation* of *Plants*? The Uſefulneſs of the *Petals* which encompaſs the *Apices* to preſs them towards the *Piſtillum*, ſo that their *Duſt* may fall in great Abundance into it; as likewiſe how neceſſary they are to protect thoſe tender Parts from the Injury of the Wind, may ſtill afford us freſh Matter of Admiration.

It is eaſy to judge, from the Function of the *Piſtillum* which receives this *Duſt*, that it does the Office of the *Parts* of *Generation* in the Female *Animals*; and that what we have before obſerved, as far as the *Intromiſſion* of the *Duſt* into the *Piſtillum*, agrees well enough with the *Conception* of the *Fœtus*.

The Nouriſhment and Growth of the *Embryo* Seed after its *Germ* is made *fœcund*, is agreeable to the Growth of the *Embryo Animal*; the Fruit which encloſes it, whether it be *Membraneous*, *Ligneous*, &c. or whether it be in the Form of a *Capſule*, *Cod*, or *Siliqua*, or is divided into *few*, or *many*, Cells or Lodgments,

ments, that *Fruit* (as *Malpighius* obſerves) ſerves as a *Matrix* to the *Seed.*

From this Deſcription of the *Parts* of a *Flower*, and the Obſervations upon their Uſes, we may draw *two* Conſequences.

The *firſt* is, That thoſe *Parts* in *Plants* which may be termed *Flowers*, are thoſe which perform the *Office* of *Generation.*

Secondly, That after the ſame Manner as in the *Animal* World, we diſtinguiſh between the *Males*, *Females*, and the *Androgynous*, we likewiſe diſcover thoſe *Diſtinctions* of *Sexes* in *Plants*, which Dr. *Grew* has already touched upon.

We may then conclude that a *Plant* may be termed *Male*, when its *Stamina* do not encompaſs any *Piſtil* or *Stile*; or that the *Stile*, if it has any, is barren, or does not incloſe an *Embryo*-Seed: Of this kind, are thoſe Strings or Bunches of *Flowers* which we call *Catkins*, or *Julii*, and the falſe Bloſſoms of *Hops*, *Hemp*, *Mercury*, and ſome others.

On the contrary, the *Female* is eaſily known by its *Piſtils* or *Stiles*, which are not incompaſſed by *Stamina*, but only guarded with *Petals* or other *Membranes*; and yet are fœcundated by the *Duſt* of *Male* Flowers, which either grow upon the ſame Plant, or upon others of the ſame Race. This *Fæcundation* is done by the Help of the Wind, which conveys the prolific *Duſt* into the *Tubes* of the *Piſtils*, when they are advanced to a fit State to receive it; as it is obſerable in the *Walnut*, *Hazle*, *Alder*, *Willow*, *Coniferous* Trees, and *Gourd* kind. *Malpighius* obſerved theſe *two* Diſtinctions in the *Flowers* of the laſt mentioned *Tribe*, as we may remark by the Figures he has given of them in his *Anatomy* of *Plants*.

The certain Mark by which we may diſcover the *Androgynous* Flowers, is the ranging of the *Stamina* about the *Piſtillum*, whoſe *Baſe* or *Body* becomes a Fruit; ſince we have already remarked, that the *Stamina*, which are the *Male* Parts, will fœcundate the *Piſtils* in the ſame *Flower*, which Part we have obſerved is found only in the *Female*. There is this only *Difference* between the *Plants* and *Animals* that are *Androgynous*; *Plants* accompliſh their *Generation* in themſelves without the Help of another Individual of the ſame *Tribe*; and the *Animals*, altho' they are endowed with *Organs* agreeable to both Sexes, are yet obliged to ſeek for one of their own Race to couple with. *Plants* for the moſt Part bring *Flowers* of this laſt Species, (that is to ſay) ſuch *Flowers* as end in *Fruit*.

This Diſcovery is the Reſult of thoſe Obſervations which have been made in the *Anatomy* of *Flowers* and *Fruit*, ſince it has been judged neceſſary, that thoſe Parts of *Plants* were the moſt proper to eſtabliſh their Characters; and it is not to be doubted but that Time and Induſtry may diſcloſe to us the *Organs* of the ſame Uſes in thoſe *Plants*, which have been ſtiled hitherto *Imperfect*, and which will no longer bear that Character when their *Sex* ſhall be determined.

We cannot in common Juſtice refuſe to give he Honour due to *John Baptiſt Porta*, for having firſt obſerved the *Seeds* in certain *Plants*, which, ill his Time, were eſteemed *barren*, as in the *Truffle* and *Muſhroom*, which has ſince been confirmed by the curious Remarks of Monſieur *Geoffroy*, Junior; thoſe of Monſieur *Marchand* on the *Agaricus digitatus niger*, and thoſe of Monſieur *le Comte de Marſigli* upon the *Lytophyton*, in whoſe *Bark* he has found the *Seed*; and we begin likewiſe to diſcover them in many *Marine Plants*, but chiefly in the *Fucus*.

Monſieur *Billerer*, Profeſſor of Phyſic at *Bezançon*, informs me that he has even diſcovered *Seed* in a River *Sponge*, called *Spongia ramoſa fluviatilis*.

There is room to believe, that if we were to take a little Pains to examine the *Marine Plants* at different Seaſons, we might diſcover their *Flowers*, or ſuch Parts as acted for them, ſince Monſieur *de Reaumur* and Signior *Michaeli*, *Botaniſts* to the Duke of *Florence*, have already diſcovered certain Parts which might reaſonably be eſteemed Dependants of *Flowers*.

This *Diſtinction* of *Sexes* being eſtabliſhed in *Plants*, is one of the moſt conſiderable Marks of the *Analogy* between *Plants* and *Animals*; but as it is not only by the *Difference* of *Sexes*, nor by the Uſe of the *Organs* of *Generation*, that we preciſely characterize the different *Animals*; ſo neither muſt we be perſuaded that theſe Differences in *Plants* can contribute to diſtinguiſh their ſeveral Tribes; for in many *Plants*, thoſe Parts which mark out the *Sex* are not eaſily diſcovered; and in others the *Flowers* are of ſo ſhort Duration, that we are not always happy enough to find them in a right Condition for Obſervation.

Thus my Friend concludes his curious *Obſervations* relating to the *Difference* of *Sexes* in *Plants*, which might very properly be followed by the *Eſſays* upon their *Manner* of *Generating*, written by my *ſelf* and *others*, wherein there are many Particulars which would render this Subject more inſtructive; but as they are already made public, I ſhall refer my Reader to them, in the *Memoirs* of the *Royal Academy* of *Paris*, for the Years 1711, and 1712; and my *New Improvements* of *Planting* and *Gardening*, &c. *Part* I. *Chap.* II. Indeed, ſince they have been abroad, I have had Opportunity and Time enough to make farther Diſcoveries; as for Example: With regard to *Freſh-Water Plants*, we may obſerve of the *Nympheas* or *Water-Lillies*, and the *Potamogatons* or *Pond-Weeds*, (which I have chiefly obſerved) that in their *Act* of *Generation*, or Time of *Flowering*, the Bloſſoms always appear above Water till the prolific *Duſt* is ripe, and caſt abroad; and as ſoon as that is over, and the *Piſtillum* or *Rudiment* of the Fruit thereby impregnated, it bends itſelf downwards till it is entirely under Water, and grows ripe in that State. Again, I obſerve that their *Seeds* always ſink to the Bottom when the Fruit is ripe enough to open itſelf, which ſhews us the Care that Nature takes to ſend every *Seed* to its proper *Matrix*; for theſe *Plants*, however their Leaves may appear to ſwim upon the Waters, yet their Roots have always hold of the Ground below. We muſt not however imagine that every ſort of *Water Plant* is faſtened by its Roots to the Earth at the Bottom of the Rivers or Pools where they grow: Both Kinds of the *Lens Paluſtris*, or *Duck-Meat*, wander from Place to Place upon the Face of the Waters, without touching the Bottom either with their Roots or other Parts; and I think the *Water Soldiers* do the ſame: But that may be enquired into by ſuch as live about the *Fens* in the *Iſle* of *Ely*, where they abound.

But it is time I return to my *firſt Propoſition* and *chief Deſign* of this Work, *i. e. to mark out, if poſſible, the ſeveral Gradations in Nature's Works*, and what Analogy there is between one Part and another; which leads me to the Conſideration of thoſe *Plants* that are very viſibly indued with all the Parts required, in *Vegetables*, viz. *Roots*, *Trunks*, *Bark*, *Pith*, *Branches*, *Flowers*, and *Fruit*; and they are of three Kinds, *Herbs*, *Shrubs*, and *Trees*.

An *Herb* is properly that *Genus* of *Plants*, whoſe *Stalks* periſh every Year, and whoſe *Foliate* or naked *Roots* put forth every Spring their freſh *Flower-Stalks:* Of theſe are the *Graſſes*, *Primroſe*, *Auricula*, *Pink*, *Tulip*, *Ranunculus*, *Anemony*, *Strawberry*, &c. and theſe are either *Fiberous* or *Tuberous* rooted, or elſe have *bulboſe*, *apple*, or *knotted Roots*; and may again be diſtinguiſhed by being *Annual*, or *Perennial* and *Vivaceous.* Moreover, the ſeveral Modes of Growth which Nature has diſtinctly given to the ſeveral Kinds of *Herbs*, are well worth our Obſervation. The firſt are the *Dwarfs*, ſuch as the *Puricula* and *Polyanthos*, or *Cowſlip* Kinds, which ſubſiſt without Props or Supporters, and form their Off-ſets or Increaſe in Cluſters cloſe about the old *Roots:* The ſecond are *Dwarfs* likewiſe, as the *Strawberry* and *Violet*, which increaſe by ſending out jointed Strings from the main *Plants*, that at every Knot take Root as they run along the Ground. The *third* ſort is of thoſe *Plants* which are *aſpiring*, but have not Strength of Body to ſupport themſelves without Stakes or Props, which they twine round about, as the *Convolvulus*, *Phaſeolus*, and ſome others; which are ſo ſtrongly impelled by Nature to twiſt about and embrace every thing that happens to be near them, that as the Loadſtone attracts Iron to it, ſo have I ſeen *Plants* of this ſort change their firſt Deſign of Growth from one Point of the Compaſs to another, to lay hold of Stakes that have been ſet a Foot diſtant from them. The *fourth* is the *Gourd*, and the *Pea* Kinds, which want the Power of twining, and yet have not Strength enough to ſupport themſelves; but Nature has provided them with other Means of bearing themſelves from the Ground, having furniſhed them commodiouſly with *Claſpers*, which catch hold of every Thing they can come near. Theſe *Claſpers*, though they do not lay hold of the Ground about them to act there as *Roots*, yet I am of Opinion they are not only deſigned for bearing up, and binding the *Plants* they are related to, to Props, but ſerve likewiſe to draw a kind of Nouriſhment from the Air, which their Mother *Plants* could not live without, and are in that reſpect analogous to thoſe *Roots* which we find at every Knot of the *common White Water Ranunculus*, which in the Summer only ſtrike into the Water, and undoubtedly receive Nouriſhment from it, though they have always a main *Root* which ſtrikes deep into the Ground: Theſe *Roots* are, in Appearance, like the Leaves of *Fennel*, and are ſo very green, that they have given us ſome room to believe the *Plant* had Leaves of *two* Kinds; but if we conſider this *Plant* a little farther, we may obſerve that it generally grows in ſtanding Pools or Ditches, which about the End of Summer are vacant of Water, and then is left upon dry Ground, where theſe *Fennel*-like *Roots* take faſt hold, and produce *Plants* for the next Year. We may alſo take notice that they are *Am-*

phibious,

phibious, living as well upon the Land as in the Waters, which is common likewiſe to the *Minths* and ſome others. And it may be remarked, that the Roots of this *Ranunculus* are perfectly formed before the Water leaves them to ſhift for themſelves to get their Living in a new Element, and are till that Time in a Manner ſuckled by the Mother *Plant*.

A *Shrub* is that Genus of *Plants*, which, in every Circumſtance, but in its Bigneſs and Duration, imitates a *Tree*; it has Branches of a woody Subſtance, and is *Perennial*: Of this Race are *Gooſeberries*, *Myrtles*, *Furze*, or *Gorſe*, *Meſereon*, *Roſemary*, *Lavender*, *Thyme*, &c. tho' ſome who are over-nice in their Diſtinctions eſteem the latter as *Under-Shrubs*: The *Shrubs* however, without that Diſtinction, may be reckoned of 4 Sorts, *viz.* ſuch as are compleat *Buſhes*, and are able to ſupport themſelves without Props, as the ſeveral Kinds of *Roſes*, *Althea Frutex*, *Gooſeberry*, *Caper*, &c. which laſt is ſo rare in *England*, that I cannot help taking notice of it in a particular Manner, having myſelf brought it to Perfection in *England*, without the Trouble of Hot-Beds or Green-Houſes; and I believe was the firſt that has made the *Caper* familiar to our Climate. In the Year 1715, my Friend Mr. *Balle* of *Camden-Houſe*, received ſome *Caper* Seeds from *Italy*, which I then ſowed in the Scaffold-Holes of his Garden-Walls, to imitate as near as poſſible the Method of their Growth about *Toulonne*, and at the ſame Time put ſeveral of the *Seeds* into a Hot-Bed: The Conſequence was, that thoſe which were ſown in the Wall-Rubbiſh ſhot near 6 Inches the ſame Summer, and the few that came up in the Hot-Bed were ſcarce 3 Inches high the *firſt* Year, although they were houſed with the tendereſt exotic *Plants*, and thoſe in the Walls ſtood the Winter without Shelter. The *ſecond* Year thoſe *Plants* in the Walls made Shoots a Foot in Length, while thoſe in the Pots hardly added 2 Inches to their Height. The *third* Year in *April* I cut the Shoots of the foregoing Summer from the *Plants* that were Abroad, leaving only a Bud or two of each near the original *Stem*, which the ſame Summer made Shoots near 3 Feet long, to the Number of about 40 upon each *Plant*, and put out Buds for Bloſſoms; but the *Plants* in the Pots did not advance above 2 Inches. The *fourth* and laſt Year one ſingle *Plant* in the Wall had no leſs than a Quart of Bloſſom-Buds upon it fit to pickle, and the *Plant* perfected ſome of its Fruit. Thus if the *Plant* be headed down in the Spring like a *Willow*, it will every Summer make a beautiful *Buſh*, and afford us as good *Capers* as grow in *Italy*.

The *ſecond* Race of *Shrubs* are ſuch as have a natural Tendency to twining or twiſting their Shoots about Props, as the *Honey-ſuckles* or *Wood-binds*, and *Jeſſamines*, &c.

The *third* Sort have *Claſpers*, which take hold of every neighbouring Twig or Stake to ſupport their rambling Branches, and thereby are defended from the Injuries they might receive by high Winds and Storms: Of this Kind is the *Vine*, and the *Maracoc* or *Paſſion-Tree.*

The fourth Kind of *Shrub* is that Sort which Nature has furniſhed with ſuch Tendrils (for climbing) as ſtrike their Points into the *Bark* of *Trees*, and which I ſuppoſe help to nouriſh the *Plants* they proceed from, as well as to aſſiſt them in their climbing; and I the rather believe they draw ſome Support from the Juices of the *Trees* they ſtrike into, becauſe the *Trees* they grow about, ſeldom or never make ſuch vigorous Shoots as others that are clear of them: Of this Kind are the *Ivy*, and *Virginia Creeper*, with ſome others.

A *Tree* is that Sort of *Plant*, which, of all others, is the moſt lofty in its Growth, and has its Parts more robuſt, firm, and laſting than any Kind of *Plant* yet mentioned: And to theſe its Perfections we may add, that it enjoys a longer Share of Life than any other *Vegetable*; and thoſe chiefly among *Trees* are of the longeſt Duration, which are of the ſloweſt Growth.

Among *Trees* we may make the following Diſtinctions.

Firſt, The *Pomiferous*, or *Apple-bearing*, as the *Apple*, *Orange*, &c. which have their *Seeds* in *Pippins*, or *Kernels*, in the Center of their *Fruit*.

Secondly, The *Pruniferous*, or *Plumb-bearing*, as *Plumbs*, *Apricots*, *Peaches*, &c. which are ſtill called *Stone-Fruit*, and carry but a ſingle *Seed*

Seed, covered with a hard thick Shell in each *Fruit*.

Thirdly, The *Nuciferous*, or *Nut-bearing* Trees, as the *Wall-nut*, &c. which differ from the foregoing, in bearing *Katkins* and *Female* Bloſſoms at Diſtances one from another upon the ſame *Trees*. They bear one ſingle *Seed* or *Nut* in each *Fruit*, which, like the former, is covered with a hard Shell, and upon that has commonly a Coat of a fleſhy Subſtance.

The fourth Kind of *Tree* is *Coniferous*, or *Cone-bearing*, as the *Fir*, the *Pine*, the *Cedar* of *Libanon*, &c. whoſe *Cones* are of a hard woody Subſtance, containing a ſingle *Seed* under each of their *Squammæ*.

The laſt I ſhall take notice of are thoſe which are *Glandiferous* and *Maſt-bearing*, ſuch as the *Oak*, *Beech*, *Aſh*, &c. which all have their *Seeds* incloſed in ſingle Shells, without Fleſh or Pulp upon them.

We may remark in the next Place, that a *Tree* is a Body on which is dependant many Kinds of vegetable Bodies. The *firſt* are thoſe which cannot ſubſiſt without it, or get Nouriſhment ſufficient to maintain themſelves elſewhere. The *ſecond* are ſuch as may be taken from it, and made ſo familiar with the Juices of the Earth, that they ſtrike root and vegetate, till they become as perfect *Plants* as the Originals they were taken from.

The firſt *Vegetative* Bodies or *Plantulæ*, which more immediately relate to the *Tree*, are the *Stamina* with their *Apices,* found in the Bloſſoms; theſe are for the moſt Part like ſo many *Fungi* taking Root in the Foot-Stalk of the *Flower*, or elſe in the Bottom of the *Calyx:* Their Office is to impregnate the *Stiles* of the Bloſſoms with the *Farina* they produce; and as ſoon as they have done that Work, they fade and drop off. We may ſee one of theſe *Stamina* with its *Apex* and *Root* done by the Microſcope, at the End of my *New Improvements of Planting*, &c. Part III.

The *Petals*, or *Flower* Leaves, are alſo *Plantulas*, almoſt of the ſame Kind; their Office, as we have already obſerved, is to guard the tender *Organs* of Generation from Cold and other external Injuries; theſe alſo having performed their Work, drop from their *Mother Plant:* The longeſt of their Life (as well as that of the *Stamen)* is *two* Months.

In the next Place we come to conſider the *Viſcum* or *Miſletoe*, which is always a *Super-Plant*, and can never be made familiar enough with the Earth to take root, or grow in it; and can only be propagated, by ſticking the *Seeds* upon the *Barks* of *Trees*, into which it ſtrikes its *Roots*, and ſupplies itſelf with Nouriſhment from their *Sap:* The Manner of its making its firſt *Roots* from the *Seed*, is, by ſending out from its Center 3 *Claws*, which fix themſelves on the *Bark* of the *Tree* in the 3 Points of a Triangle, and are at their Extremities like the Mouths of *Leeches*, when they are diſpoſed

iſpoſed for drawing in their Nouriſhment: Theſe faſten themſelves on the *Bark* of the *Tree*, nd begin to ſeparate at the Center of the *Seed*, s if each *Claw* was to become a diſtant *Plant*; ut a Year or *two* makes us know the contrary; he 3 *Claws* are then ſwoln or enlarged enough o meet at their Root-Points, and are ſo ſtrong-y united together, that they make the Foun-ation but of One *Plant*; and the Place of heir firſt joining in the Center of the *Seed* opens nd divides, ſo that there appears 3 diſtinct ranches ſpreading from the *Root*; after this it roceeds to bloſſom, and bear Fruit, and will ve to a great Age. It is remarkable that there but one Sort of *Miſletoe* in *England*, not-ithſtanding that which grows upon the *Oak* as been the moſt admired; and I do not find but at the *Miſletoe* of *Apple-Trees*, or any others, ave the ſame Parts with that of the *Oak*, and have lſo the ſame Virtue; for the *Plants* which the *iſletoes* grow upon ſerve only to them, as the arth does to any *Herb* that is planted in it, at is, to furniſh it with a convenient Supply f Nouriſhment. And I have not yet obſerved at the Phyſicians have made any Diſtinction etween particular *Plants* growing upon *Sand*, *lay*, *Gravel*, or *Chalk*, &c. becauſe, as I ſup-oſe, they think a *Plant* ſtill preſerves its origi-al Virtue, let it grow in any Soil; but this ill admit of many Diſputes: We know that alf a Dozen *Grafts* or *Cyons* of the *Golden-ippin* may be ingrafted upon as many different

rent Sorts of *Trees*, and yet the Properties of the *Golden-Pippin* ſtill preſerve themſelves in all the *Grafts*, though they have different Kinds of Nouriſhment from their ſeveral Stocks: But an *Oak* planted upon a dry Hill will not ſhoot a third Part ſo much as another of the ſame Kind will do in Clay or a moiſt Bottom; and the Difference of the Grain of their Wood, or Size of their Veſſels, are in Proportion to the Growth of thoſe *Trees*; from whence we may judge that the Juices filtered through the ſmall *Tubes* of One *Tree*, muſt be twice as fine as the Juices paſſing through the large *Tubes* of the Other; and then a *Cube* of an Inch taken out of the Solid in the ſmall *Tree*, muſt contain a different Proportion of Virtue, from a *Cube* of the ſame Dimenſions taken out of the larger *Tree*; but this Caſe I ſhall hereafter treat of more at large.

But I cannot leave the *Miſletoe* without taking notice of *two* Things: In the firſt Place, as to its Method of Growth, the ingenious Dr. *Douglas* has made ſeveral capital Diſcoveries, which he has communicated to the Royal Society, and is yet ſo obſervant in the Progreſs of that *Plant*, that we expect he will oblige us with farther Obſervations. On the other Hand, (after it has been conſidered botanically) and my worthy Friend Sir *John Colebatch* has given us a generous Account of its Virtues, in a ſmall Tract ſold for 1 *s.* 6 *d.* and with the true Spirit of a *Briton*, has put the Key of Life (as

I may call it) in the Hands of thoſe who are troubled with the worſt Diſtempers, I mean *Epileptic Caſes*, which ſometimes have led Men to that Extravagance, that in former Ages they have been eſteemed as mad Men, People bewitched, or poſſeſſed with Devils. And theſe deplorable Circumſtances of Mankind may have given Occaſion to *two* Things, which are very remarkable; *firſt*, That when the *Druids* lived, they had the Knowledge of Diſeaſes which were incident to human Bodies, and had the Knowledge of the *Miſletoe* in this Caſe, by which they might probably appear as Demi-Gods in the Eyes of the People. *Secondly*, That the *Oak*, which was held as ſacred by them, was chiefly the *Tree* that the *Miſletoe* grew upon; not to mention the other good Qualities of the *Oak*: And from hence it may be likewiſe, that by Tradition, the *Miſletoe* of the *Oak* is now in Eſteem beyond the reſt.

We are next to conſider ſuch *Moſſes* as are found growing upon the *Barks of Trees*, and chiefly upon ſuch as are diſtemper'd and declining in their Vigour; for it can hardly be ſaid that a healthful *Tree* ever produces any *Moſs*. The *Moſſes* which are the greateſt Sign of ill Health in *Trees*, are the *Cup-Moſs*, and ſome others which branch like Coral Lines, and a third Sort reſembling a Bunch of Wooll: Theſe are all White, and bear *Seeds*, but are not in other Reſpects ſo perfect as the *Green Moſſes*. The

Time of their ſhooting is in *October*, when the Rains begin to fall.

We now come to treat of ſuch *vegetable* Bodies as are depending upon *Trees*; but may nevertheleſs be made ſo familiar with the Juices of the Earth, that from a ſingle Part of a *Tree*, they become *perfect Plants*. The firſt of theſe are the *Leaves*, which contain in themſelves ſuch *Vegetable* Principles, as give them a Power of producing as *perfect Plants* as the Originals they were taken from. For Inſtance, plant the *Leaves* of *Orange-Trees*, or other Ever-Greens, in freſh Earth, they will ſtrike root, and produce *perfect Plants*, if they are well watered, and kept in the Shade, as myſelf and Mr. *Thomas Fairchild* of *Hoxton*, with ſome others, have experienced; ſo that the *Leaves*, beſides their Uſe in helping the *Buds* to germinate while they are growing upon the *Tree*, may be then eſteemed perfect *vegetable* Bodies. The *Leaves* of *Aloes* being ſet in like Manner will produce *perfect Plants*; and even the *Fruit* of the *Opuntia* or *Indian* Fig, when it is full grown, being ſet into the Earth, will ſtrike root and become a *Plant* as *perfect* as the *Mother* it was taken from: By this Method I have often ſaved ſeveral *Plants*.

The *Twigs* and *Branches* of *Trees* are really ſo many *Plants* growing upon one another; for as they all proceed from *Buds*, or may rather be ſaid to be *Buds* explained, we may thence infer that the *Buds* they came from did in every

Reſpect perform the Office of a *Seed:* The *Twigs* take Root in the *Branches,* and the *Branches* take Root in the *Stem.*

It is to be obſerved, that all theſe, taken ſe-arately, may be made by ſome Means or other o take Root; and even the very *Roots* them-elves of a *Tree*, being cut to Pieces, and plant-d after a proper Method, will vegetate and ecome perfect *Trees.* Dr. *Agricola* of *Ratiſ-on,* in his *Philoſophical Treatiſe of Agricul-ure,* preſcribes ſeveral Methods for raiſing *Trees* om their different Parts, by the Aſſiſtance of *Vegetative Mummy,* as he calls it; and I have lready tried ſome of his Experiments, which nſwer beyond Expectation; the Account of which may be ſeen in my Preface to the *Engliſh* Tranſlation of his Book. He has 4 or 5 Kinds f *Vegetable Wax* or *Mummy,* that he makes ſe of for propagating all Sorts of *Trees:* His Method is to dip both Ends of his Cuttings, whether of *Roots* or *Branches,* in one or other f theſe Preparations, and by that Means the uices contained in each Cutting are preſerved nd nouriſhed till they are diſpoſed for ſtriking oot, and then the *Mummy* cracks and gives way to the tender *Fibres.* I am of Opinion, was this Way to be farther conſidered, and ome Improvements added to that Gentleman's Method, we ſhould not only be ſure of making he Cuttings of every Kind of *Plant* ſtrike Root, but forward them extremely in their Growth; as for Example, was I raiſe *Peach* *Trees*

Trees from Cuttings, I would get together a large Parcel of young Shoots of *Peach-Trees* about *Midſummer*, preſs the Juice from them, and afterwards put in a Dunghill, or ſome other Heat equal to it, to digeſt for 3 Weeks or a Month; I would likewiſe burn a large Parcel of *Peach-Tree Branches*, and lay by their Aſhes for 3 or 4 Months, or more, till they became almoſt like Earth itſelf; of theſe *two* Ingredients I would make a Paſte to incloſe the Bottom Part of my *Peach* Cuttings, ſealing the Top of each Cutting firſt with common Pitch, or ſome ſuch like Matter, and then put them in the Ground, and keep them well watered: I ſuppoſe, if Cuttings, ordered after this Manner, ſtrike root, they cannot fail of a vigorous Growth, as the Paſte they are incloſed in contains every Thing agreeable to the Nature of the *Plant* it incloſes; and ſo the Cuttings of every Sort of *Tree* may be ordered after the ſame Manner.

Could we by this, or Dr. *Agricola*'s Way, be certain of the Growth of the Cuttings we plant, we ſhould be ſure of having ſuch a Collection of *Fruit* as we moſt deſire; for the *Branches* or *Twigs* may be cut when the *Fruit* is ripe upon the *Trees*. This leads me to conſider the Uſe of *Soap*, which I was informed ſome Time ago has an extraordinary Effect on the Vegetation of *Trees*, by anointing the *Roots* with it.

I was told by a curious Botaniſt, that, in the Year 1720, he tranſplanted a *Bay-Tree* of an nch Diameter in the *Stem*; but for the more onvenient Carriage of it from Place to Place, e cut down the *Plant*, and left only 6 Inches f the *Stem* remaining; and at the ſame Time leared the Earth from the *Roots*, and anointed hem well with common *Soap*; in this State e planted it in a Pot, and watered it every Morning; the Conſequence was, as he ſays, hat in one Month it had ſhot out 3 *Branches*, ach about 2 Feet long, out of the hard Wood f the *Stem*. This quick *Vegetation* ſeemed ſo xtraordinary to me, that I could not help mmediately inquiring into the Nature of *Soap*, nd the Ingredients of its Compoſition, which found to be *Aſhes* of *Vegetables*, *Oils* of *Vegetables* or *Fiſh*, or *Tallow* of other *Animals*: concluded then that the *Aſhes* and the *Oils* of *Plants* might reaſonably contribute to *Vegetation*; and the common Cuſtom of manuring Lands in the Weſtern and other Parts of *Engnd* with Fiſh of ſeveral Kinds, made me dge that their *Oil* muſt contribute to the Growth of *Plants*; and the common Method f laying dead *Animals* to the *Roots* of decayng *Trees*, to invigorate them and reſtore their Health, gave me good Reaſon to approve of the Uſe of *Soap*, with which I have anointed ſome Cuttings, eſpecially of *Vines*, in *June*, which ave preſerved their *Leaves* freſh and green, nd in *Auguſt* began to ſhoot.

But beſides the Help which *Soap* may giv
to the *Vegetation of Plants*, I am apt to believ
it will be of great Uſe in the Removal of *Plan*
to any great Diſtance; for what chiefly give
the Check to a *Plant* in its Removal, is, tha
the Air ſhrinks and dries up the Veſſels an
Parenchymous Parts of the *Root*, ſo that the
are not for a long while in a Condition to draw
in their *Sap* freely; but I conceive that *Soa*
will help this Caſe, if the *Roots* are well anoint
ed with it when they are freſh taken out of th
Ground, eſpecially in ſuch *Plants* as are Tap
rooted; and it will be farther of Uſe in keep
ing the Air from the *Roots* after the *Plant* i
ſet in the Ground, till the Earth is firmly ſet
tled about them. But as I have yet made bu
few Experiments in this Way, I ſhall leave i
to others to try ſome *few* ordinary *Plants* wit
it, before they run the Hazard of a *large* Quan
tity; for whether it will agree alike with a
ſorts of *Plants*, I cannot determine.

As we have already taken notice of the mo
remarkable Particulars relating to *Plants*, w
come now to ſay ſomething of their *Degre*
of *Growth*, and their *Progreſſion* in *Weight* an
Stature, from the Time they were incloſed i
the *Seed*, to the Fulneſs of their Perfection. I
order to this I ſhall begin with the *Weight* o
an *Acorn*, and compare it with a full grow
Oak, which it may produce; I ſuppoſe abou
12 *Acorns*, freſh from the Trees, weigh a
Ounce, and an *Oak-tree* in its moſt perfect Stat

(which I take to be 100 Years Growth) with its *Roots* and *Branches*, may probably weigh about 15 Ton; ſo that in 100 Years a ſingle *Acorn* weighing one 12th of an Ounce, has increaſed its Weight 33,600 Pounds, which is 537,600 Ounces, or an Increaſe of Parts of equal Value with its firſt Weight 6,451,200; ſo that one Year with another, for 100 Years, it gained 64,512 Parts, which is 5376 Ounces; for it would be ridiculous to imagine, as ſome have done, that an *Acorn* that had ſhot vigorouſly the firſt Year, ſo as to be perhaps 6 or 8 Inches high, ſhould weigh as much as a Year's Growth when the *Tree* is 50 Years old; or that every Year, during the whole Time of its Growth, it gains equal Sums of Weight: No, the Caſe is quite otherwiſe, as we find by Experience: The *firſt* Year the young *Oak* weighs about 3 Times as much as the *Acorn*, and the *ſecond* Year about 3 Times as much as the *Tree* of one Year, and the *third* Year 3 Times as much as the *ſecond*, and ſo on in that Mathematical Progreſſion, during the chiefeſt Time of its Growth; not to reckon the Weight or Number of the *Acorns*, which it might reaſonably bear, from about its 30th Year to the 100th Year of its Age, which I conceive cannot be leſs than 100 Buſhels, which may probably contain in Number 384,000 *Acorns*; (for reckoning 60 *Glands* to the Pint, which is 3,840 to the Buſhel, in 100 Buſhels there will be the aforeſaid Number) and if we ſuppoſe them to weigh after the Rate of 12 to the Ounce, the whole Amount of Weight will be 32,000 Ounces, or 2000 Pounds. But I have been as moderate in this Computation of the *Acorns*, as in the Weight of the whole Body of the *Tree*, with its *Roots* and *Branches*, which I have only reckoned 15 Ton. I once remember that 4 Sacks of *Acorns* were gathered from one *Tree*, which amounted to 16 Buſhels; and then one may reckon 5 Buſhels to be the Produce of a good *Tree*, one Year with another, which, for the Space of 100 Years, amount to 500 Buſhels, weighing (according to the foregoing Account) 10,000 Pound, and are in Number 1,920,000; ſo that if we allow the Weight of the *Leaves* and *Huſks* of the *Acorns*, which the ſame *Tree* produced in 100 Years, to be equal to the Weight of the *Glands*, then that *Tree* has drawn Nouriſhment from the Earth, Water, and Air, in that Period of Time, 524,000 Pounds Weight, which is a wonderful Increaſe.

In Annual *Plants*, ſuch as the *Cucurbit* or *Gourd* Kind, the Proportion of Weight in the full-grown *Plant*, compared with the Weight of the *Seed*, is much the ſame with that in the *Oak*; and the progreſſive Growth of the *Plant* I ſuppoſe to be much like that of the *Oak*, in Proportion to the Length of its Life. In the *Gourd* Kind we may reckon a *Seed* to weigh about a 32d Part of an Ounce, which *Seed* coming to explain itſelf into a *Plant* of full Perfection,

tion, will ſpread its *Vine* in 6 Months to ſuch a prodigious Length, that I have meaſured from the extreme Point of one *Branch* to the Extremity of another above 30 Feet, at which Time there were growing on it 5 large Fruit, weighing about 20 lb. a Piece one with the other, and as many ſmall ones as might probably weigh 30 lb. The *Leaves*, *Stalks*, and *Roots*, I ſuppoſe, weighed about 40 lb: ſo that the whole had gained in 6 Months near 170 lb. Weight, which is 87,039 thirty-ſecond Parts of an Ounce more than the Weight of the *Seed.* The *Fruit* of the largeſt Kind of *Gourd* is of an Egg-like Figure, ſometimes 2 Feet in Length, and the Diameter of its Breadth a Foot; and this vaſt Fruit is not longer than 40 Days coming to its full Growth; now ſuppoſing it but 20 Inches long, and 10 Inches thick, it then grows half an Inch in Length, and a Quarter of an Inch in Breadth, one Day with another.

The *Leaves* of the ſame *Plant*, when they are full grown, meaſure about 10 Inches over; theſe, from their State in the *Bud*, till they are fully explained, require about 7 Days; ſo that in the Progreſs of their Growth they are expanded about an Inch and an half one Day with another. Now when *Vegetables* grow with this ſudden Increaſe, I ſee no Reaſon why we may not obſerve their Motion with a good *Microſcope*; for every one knows (who has been converſant with *Microſcopes)* that we have ſome Glaſſes which will magnify a ſimple Point, ſuch as is not bigger than a Grain of Sand, ſo as to make it three Inches over, or ſhew a Diameter of as much; then ſuppoſing an Inch and an half is the Produce of 24 Hours, and allowing that an Inch in Length is equal to 50 Points, then in 24 Hours the *Leaf* grows 75 of theſe Points; and if we allow every one of thoſe Points to meaſure 3 Inches by the *Microſcope*, the Produce of a Night and Day is 18 Feet 9 Inches; ſo that if we were to fix a *Microſcope* over one of theſe *Leaves*, when the Sun ſhines upon it, I do not doubt but we might obſerve the Circulation of the *Sap* in the *Leaf*, and have the Satisfaction of ſeeing the *Plant* grow, and its Parts move, much quicker than the Minute-Hand of a Clock, and without Pauſes or Reſts in its Motion.

As the Growth of *Plants* is thus eaſy to be diſcerned, and the Circulation of their Juices, and the Mode of their Generating, is now pretty generally received, ſome unskilful People have alſo thought that ſome of them had a Share in Senſation, as the *humble* and *ſenſitive Plants*, the *Wild* or *Spurting Cucumber*, the *Seed-Pods* of *Female Balſams*, with others of the like Nature; but this is far from Reaſon, when we conſider that the Fruit of the *Wild Cucumber* never flies from its *Vine* till its Veſſels are over-replete with Juices, which is the ſame Caſe with the *Seed-Pods* of *Balſams*, whoſe Parts are ſo full when they are quite ripe, that the *Pod* burſts open upon the leaſt Touch; but the falling down of the *Leaves* of the *humble Plant*, and the cloſing of thoſe of the *ſenſitive*, ſeems either to proceed from the Tenderneſs of the Veſſels, which convey their *Sap* into them, and faſten them to the *Twigs* they grow upon, or elſe that they cannot bear any Cold or uncommon Motion of the Air. For in a warm Day, when the Air is ſerene, theſe *Plants*, if they ſtand abroad, are not affected by it, or will ſcarcely give way, though they are touched with ſome Violence; but if the Weather be cool, they are ſeemingly declining, and reſiſt the Touch without any Alteration. On the contrary, when they are kept continually under Glaſſes, and the Sun ſhines upon them, they do not only decline if they are touched with the Hand, but are ſubject to the ſame Alteration by any extraordinary Preſſure or Motion of the Air, made by a Fan or Handkerchief at ſome Diſtance from them; and I obſerve that they never appear in a right State of Health, or have their Leaves expanded, from the Time of the Sun's ſetting till it is riſen.

Thus I think I have remarked what is moſt neceſſary to be obſerved in *Plants*, and may be ſufficient to give us an Idea of their Share of Life and Growth; they have *perfect Form*, every one according to its Tribe, and may be as eaſily diſtinguiſhed from one another, as the various Bodies obſervable in the *Animal* Kingdom.

Explanation of the Figures relating to Chap. III.

PLATE I.

Fig. III. *The* Echinomelocactus, *or* Melon-Thiſtle, *growing in* Nevis, St. Chriſtophers, *and others of the* Carribbee Iſlands, *commonly called, in thoſe Parts,* Turks-head, *or* Popes-head.

Fig. IV. *The* Upright Torch-Thiſtle, *growing wild in* Jamaica, *and other Parts in the* Weſt-Indies, *near the ſame Latitude.*

Fig. V. *The* Optuntia *or* Indian Fig-tree, *growing in* Carolina, *and about* Florida.

Fig. VI. *A* Shoot *of the foregoing* Plant *ſhewing its* Leaves.

CHAP. IV.

Of Immoveable SHELL-FISH, *and of ſuch as have* Local Motion; *with Variety of Obſervations upon the reſt of the* FISH-KIND *in* SALT *and* FRESH *Waters.*

HAVING taken notice of ſuch *Plants* as are eſteemed the moſt *perfect*, and made mention of the moſt remarkable Particulars relating to their State of Life and Manner of Growth, I come in the next Place to treat of thoſe *Bodies*, which, like *Plants*, want *Local Motion*, but have ſuch a Share of Animal Life as to afford them the Power of Senſation.

Of theſe there are the *Oyſter*, the *Muſcle*, the *Cockle*, the *Barnicle*, &c, which are never capable of removing themſelves from their firſt Station, as far as I can yet learn, notwithſtanding we find of them *in* and *about* ſome Shores or Rocks, where they had not been obſerved before; but this happens from the *Spawn* of them, which flits upon the Waters, and is carried from Place to Place by the Winds or Tides.

It is remarked by ſome curious Obſervers of Nature, that ſuch *Shell-Fiſh* as are *immovable* are *Androgynous*; that is, each reſpectively poſſeſſes the *Male* and *Female* Parts of Generation, ſo as to be capable of impregnating itſelf without the Help of another of the ſame Kind; which is the ſame Caſe with that which I have mentioned to be natural to *Plants*, which are each of them confined to their ſeveral Stations, without the Power of ſeeking at any Diſtance one of a contrary Sex; for which reaſon we may judge that the neceſſary Parts, for propagating of their reſpective Kinds, were thus diſpoſed by Nature.

The *Oyſter* has its Situation under ſuch a Depth of Waters, as ſeldom or never to be left uncovered by them; but the *Muſcle* has generally its Situation in ſuch Places upon the Shore, or Rocks, as by the Fall of the Tides they become expoſed to the open Air; and commonly are found in Beds of large Extent, ſometimes covering near an Acre of Ground, as we may find in ſeveral Places on our *Engliſh* Coaſts: The *Cockle* is always bedded in the Sand upon thoſe Shores that are uncovered at low Tides, and are ſeemingly fed like *Earth-Worms*, which draw their Nouriſhment only from the Earth or Sand which paſſes thro' their Bodies; but *Muſcles* and the *Oyſter* we often find will feed upon Sea-Weeds when they can come at them; though I am of Opinion that their moſt ordinary Food is Mud and the Waſh of the Sea. About three Miles from *Colcheſter* there are little Pits near the River, which receive the Tides at High-Water, in which they place Baskets of *Oyſters* newly brought from the Sea, letting them remain about 15 Days or 3 Weeks, to purge themſelves from their natural Food, and grow green by feeding upon a ſort of *Crow-Silk*, which is in great Plenty in thoſe Pits; and then they are reckoned in a right State for Barrelling up for the Markets, and are allowed to be much better reliſhed than any other *Oyſters* found in our *Britiſh* Seas, tho' there are much larger about *Tenby* and *Milford-Haven*. In ſome Parts of the *Eaſt-Indies* there are *Oyſters* of that prodigious Size, that a ſingle *Shell* will weigh above 100 Weight: Mr. *Pocock*, one of the Chaplains to the Royal Hoſpital at *Greenwich*, has one of them in his Cabinet of Rarities. What we may obſerve more particularly in this Species of *Shell-Fiſh*, is firſt, that they have no bony Subſtance within their fleſhy Parts; nor do they enjoy the Benefit of Sight, Hearing, or Smelling, that I can yet diſcover; neither indeed do I think the neceſſary *Organs* for thoſe Senſes can reaſonably be ſought for in ſuch Bodies as have a fix'd State of Life; the Senſes of Feeling and Taſting being ſufficient for the Maintenance and Support of them. Theſe enjoy a more perfect Share of Life than *Vegetables*, which have only a Degree of Life, without any Senſe that we can yet find out. Again, as the Bodies of theſe *Shell-Fiſh*, of themſelves, would perhaps be ſubject to the voracious Appetites of the *Fiſh* of Prey, Nature has wiſely given them Coverings or Caſes of ſo hard a Subſtance as to ſecure them from that Danger. Theſe *Shells* have a kind of vegetative Growth, and have alſo Veſſels of Communication with the Animal they contain; ſo that it ſeems as if the Juices of the one were neceſſary for the Support of the other; which Caſe is well worth the Conſideration of the Curious, as it is partly the ſame in the *Folium Ambulans*, or *Walking-Leaf*, which I ſhall treat of at large in the Chapter of *Inſects*.

There are yet many other Kinds of *immoveable Animals* of the Waters, which I might have mentioned in this Place; but at preſent I ſhall content myſelf with giving but a few Inſtances of ſuch Things obſervable in Nature's Works, as may tend to explain to us what Affinity the ſeveral created Bodies have one to another, both with regard to their Frame, and their Power of Growth and Motion: And for better Information, ſhall chiefly draw my Inferences from ſuch Subjects as may be come at with the greateſt Eaſe.

The next I ſhall take notice of is the *Scallop* and *Pectunculæ*, which laſt have a perpendicular Motion in the Water, raiſing themſelves from the Bottom in a right Line to the Surface, by flapping their *Shells* with a very quick Motion; and I ſuppoſe the *Scallop*, which ſeems only to be a larger Kind of them, has likewiſe the ſame Mode of Motion, which is worthy our Enquiry.

I have juſt now met with ſome very curious Obſervations of Mr. *Leuwenhoek*'s, relating to *Muſcles*, in the *Philoſophical Tranſactions*, Nº 336, and eſpecially tending to prove them *Androgynous*. This learned Gentleman firſt obſerves that *Muſcles* lay their Eggs in Strings, regularly placed one by another upon the Outſide of their *Shells*, and that this *Spawn* or *Eggs* continually increaſe in Strength till they become perfect *Muſcles*, at which Time Part of their *Egg-ſhells* is diſcoverable upon the outward Covering of the *Fiſh*, till that Coat is hardened or changed into a firm *Shell*.

The next Obſervation was made in Winter, upon the *Ovarium* or *Egg-Neſt*: At that Seaſon our Author diſcovered ſome of their *Eggs* were placed on the Outſide of the *Shells*, while others were yet lodged in the *Ovaries*; theſe

unborn

nborn *Muſcles* had their ſharp Ends faſtened to
e String or Veſſels by which they receive
eir Nouriſhment. Some Days afterwards
e obſerved 25 other *Muſcles* that had not yet
laced their *Eggs* upon their *Shells*; from theſe
e took a great Number of *Eggs*, which he
xamined with the *Microſcope*, and found ſome
f them ſo ſmall, that he could but juſt ob-
rve the Figure of them; from others he took
ome that were larger, of a browniſh Colour,
ixed with little Specks; in theſe *Eggs* he diſ-
overed ſome of the Parts of the little *Fiſh*, but
e ſmaller *Eggs* are tranſparent. In fine, ha-
ing examined a great Number of *Muſcles*, and
ound the *Ovaria* or *Egg-Neſts* in them all, he
oncludes, that every *Muſcle* brings forth
oung ones, laying them not only upon their
wn *Shells*, but upon thoſe of others; ſo that
ometimes a *Muſcle* is quite covered over with
ggs. He tells us, that it is his Judgment,
fter ſeveral Obſervations, that moſt of the
hell-Fiſh bring forth their Young without the
elp of *Males*; each particular *Fiſh* impreg-
ating itſelf; for that in all thoſe *Muſcles* which
e had obſerved, he found in the ſmalleſt Par-
icles of their Beards, by the help of *Microſcopes*,
hat in each Part (which was not the 100th Part
o big as a common Grain of Sand) there was
vaſt Number of Motions, which remained
or ſome Time after it was taken off from the
ody of the *Muſcle*. In theſe Parts he has ſe-
eral Times obſerved *Animalcules* ſwimming;
and

and the ſmall Parts that lay round about we put into ſuch a Motion, that he ſays one ma be apt alſo to take them for *Animalcula*; an this gives me reaſon to believe that the *Bear* of the *Muſcle* may perhaps do the Office of th *Male* Part. But this is only Conjecture, an deſerves to be more duly conſidered.

As to the Food of *Muſcles*, he gives us roo to ſuggeſt that it is the fineſt Sandy Parts, an ſome Kind of Sea-weed; for he has been as accurate in the Deſcription of the Stomach, as h has been in his Enquiry after thoſe Parts whic are appointed for Generation.

We ſhall next treat of ſuch *Shell-Fiſh* as hav *Local Motion*; ſuch as *Lobſters*, *Crabs*, *Star Fiſh*, &c.

The Habitation of the *Lobſter* is in Holes among the Rocks, where the Sea never leav them; they have a Power of moving forwar with great Nimbleneſs, either by ſwimming i the Water by the Aſſiſtance of their 8 ſmalle Legs, placed 4 on each Side, or the Flappin of their Tail, or the Fins lodged under i Theſe *Fins* are edged with a kind of Fringe the better to hold for ſome Time their *Spaw* which is not much unlike *Cole* or *Cabbage See* but chained together. Its Motion at the Bottom of the Sea, or upon the Rocks, is aſſiſte by its larger *Claws*, wherein they have ſo muc Strength as to reſiſt a Force equal to 60 Poun Weight; and by means of *Muſcles* in thoſ *Claws*, are capable of pinching any thing the

n lay hold on with that Strength, that it re-
ires a conſiderable Force to make them quit
eir Hold; and, as I am informed by ſome
bſter Fiſhers, will rather loſe their *Claw* than
rt with what they have laid hold of: Which
ings to my Mind what is related of them in
e *Memoirs of the Royal Academy of* Paris, *for*
Year 1711, where it is reported, that if
e of the larger *Claws* is broken off, and the
bſter ſtill remains in the Sea, it will grow a-
in, or be renewed; which is the Reaſon, per-
ps, that we ſeldom find the large *Claws* of
ſame *Lobſter* both of one Bigneſs. If this
true, we may ſuppoſe that the State of
bſters is partly *Vegetable*, partly *Animal*; for
getables have a Power of renewing their
ughs or *Branches* when they are broken or
off; but no *Animal* that I know of has the
wer of renewing a loſt Limb.

To aſſiſt them in catching their Prey, they
e two Eyes, and two jointed *Antennæ*, which
ch a conſiderable Length before their Bo-
s, and in which I ſuppoſe there is contained
ir moſt ſubtile Senſe of Feeling, even ſo as
give them notice by the trembling of the
aters of the Approach of their Enemies,
ich are out of the Reach of their Eye-ſight;
perhaps to feel out their Food lying at the
ttom of the Sea, which the Situation of their
es cannot allow them to diſcern. For the
ter Maceration of their Food before it enters
Stomach, their Mouths are guarded by 4 or
5 Pair

5 Pair of toothed Jaws, each of which has Power of acting by itſelf.

I have not yet had Opportunity of ſatisfyi myſelf, whether there are *Male* and *Fem* *Lobſters*, or whether they act in Generation *Snails* do; that is, if each reſpective *Lobſte* in the Time of Coupling, performs the *Ma* and *Female* Act at the ſame Time: For in a the *Lobſters* I have opened in the Months *June* and *July*, I find either the *Spawn* is excluded from the Body, and lodged among th *Fins* under the Tail; or elſe I have obſerved *Spawn*-like Body (which I ſuppoſe to be th *Ovaria*) running through the Fleſh of the *Lo ſter*, from a Place near the Stomach to the *Orifice* under the *Tail-Fins*. But this Matte I ſhall treat of more at large, when I have ha Opportunity of examining it with more Exactneſs.

The Natural Hiſtorians have reckoned ne 30 ſeveral Sorts of *Lobſters*, all of which a clothed with *Shells*; and by what I can lear there are not fewer Kinds of *Crabs*, ſome them very poiſonous: The larger Sorts of the are commonly found among the Rocks, and like *Lobſters*, are never uncovered by the Waters; but the ſmaller Kinds are often found upon the Shores at Low-Water. I do not y know that any of this Race have the Power Swimming, or have any Parts analogous *Fins*.

Th

The *Crab* which I ſhall chiefly take notice
f, is that Sort commonly found upon our *Eng-*
ſh Coaſt : It is like the *Lobſter*, with regard to
s Number of Legs and large Claws, whoſe
exture and Parts are nearly the ſame with
hoſe of the *Lobſters*; their Body is placed in
e Centre of their Legs, like that of the *Spi-*
r, but their Motion is Latitudinal or Oblique,
ntrary to that of the *Lobſter*, which is Di-
ect: This Side-Motion of the *Crab*, I ſuppoſe,
appens for want of that jointed Tail to guide
in its Motion, which ſerves partly as a Rud-
er to guide the *Lobſter* forward. The Eyes
f the *Crab* are more prominent from the Body
han thoſe of *Lobſters*, and are ſo ſituated, that
hey can turn them to any Point which they
e prompted to move to; for which reaſon I
ppoſe they are wanting of thoſe *Antennæ*, or
eelers, which we obſerve in *Lobſters* ; but ſome
emark that their Side-Movement is directed by
eir *right* Legs, which they ſay are always
rger than the *left*. I ſuppoſe the Manner of
eir Generation is ſomewhat like that in *Lob-*
ers, although they want thoſe *Fins* under the
ail for the Preſervation of the *Spawn*. For I
ave obſerved in the ſmaller Kind of *Crab*,
hich I ſuppoſe is in moſt Reſpects analogous
o the larger Sort, that the *Eggs* are preſerved
n a Knot cloſely linked together immediately
nder the Apron, after they are excluded from
he Body of the Mother; and the Time of
their

their Spawning is the ſame with that of *Lobſters.*

The *Star-Fiſh* is another *Genus* of *moveabl* *Shell-Fiſh*, tho' its Motion is trifling in Compariſon with the former; and of theſe there ar ſeveral Kinds, tho' I have ſeen but 3 Sorts, *viz.* the *Stella Marina Major*, the *Stella Marin* *Minor*, and the *Stella Marina Arboreſcens*; The Motion of the firſt 2 is performed by bending their jointed Rays backwards and forwards; but the latter I ſuppoſe muſt be much quicker, if it can make uſe of all its Ramifications, which are ſome thouſands in Number The largeſt of this Kind that I have ſeen is now in the *Muſeum* of the Royal Society in *Cran* *Court*, *Fleet-ſtreet.* The Mouths of all thi Kind are in the Center of their Bodies; and do not find any *Orifice* for the Diſcharge of Excrement, no more than for the Service of Generation. So odd a Creature as this is wel worth the Contemplation of ſuch curious Perſons as live near the Sea, where every Day they have Subjects enough to employ their Curioſity and improve their Underſtanding.

I now come to treat of ſuch other *Shell-Fi* as move from *Place* to *Place*, by Means of a undulating Motion of their fleſhy Parts out o the *Shell*, after the Manner of *Snails:* Of theſe there are ſeveral Kinds, ſome of which ca ſwim or creep at their Pleaſure; and others only creep upon the Sands or Rocks. The *Periwinkles* or *Water-Snails*, whether in the Se

o

or in the Rivers, have the ſame Mode of Motion; we may obſerve them ſwimming on the Surface of the Waters, with their whole Body and Shell reverſed in the Water; ſo that they ſeem to take hold of the Air, and to receive that Reſiſtance from it, which common Snails do from the Earth, or other ſolid Bodies which they creep upon. They have a Power of contracting their Bodies ſo as to incloſe them in their *Shells*, and at their Pleaſure to relax their Parts, or expand them to ſuch a Degree, as to fill up twice he Space of the *Shell*. The Fleſh of theſe Creatures is *Viſcous*, and of a porous Texture, by which Means they have a Power of adding continually to the Growth of their *Shells*, or reinſtating any broken Part of them; for the *Viſcous* Matter contained in their Bodies iſſues ut in great Abundance to any fractured Part of he *Shell*, and ſoon hardens and joins itſelf with t. So likewiſe when the Bodies of theſe Creaures grow too big for their *Shells*, a Supply of he ſame Juice ſerves to enlarge their Coverings. I ſuppoſe their Generation is much the ſame vith that of *Land-Snails*, which ſee hereafter.

The Chief of this Claſs is the *Nautulus*, *Purpura*, *Strombus*, *Murex*, *Buccinus*, *Trochus*, *oncha*, &c. the Beauty of whoſe *Shells*, with he ſurpriſing Variety in their Structure, is as emarkable as the Diverſity of Feathering in Birds, or the various Colouring and Spotting f their Eggs. The great Extent of ſeveral of heſe *Shells* is ſurpriſing, ſome of them weighing near 10 Pounds a-piece, without the *Animals* in them. But whoever would ſatisfy their Curioſity in theſe Matters, may have Recourſe to the excellent Cabinets of Sir *Hans Sloane*; the *Muſeum* of the Royal Society, *London*; Mr. *Vincent* at *Harlem*; Dr. *Ruyſh* and Mr. *Albertus Seba* at *Amſterdam*; where they may behold with Admiration the Beauties collected by thoſe learned Gentlemen. But that we may have ſome farther Account of the Creatures which inhabit theſe teſtaceous Bodies, let me once more recommend the Obſervance of them to thoſe Gentlemen who have the Pleaſure of living near the Sea.

I come now to treat of ſuch *Fiſh* as are Inhabitants of the *Salt* and *Freſh* Waters, that are framed for ſwimming only, and are of ſuch a Compoſure and Texture of Parts, as to breathe only an Element as denſe as Waters; for the Air to thoſe Creatures is too fine and rarified for them to ſubſiſt in; ſuch as is the Caſe of ſome *Animals*, which are taken up upon high Mountains; for there the Air is ſo much thinner than the uſual Air of their Breath in their natural Station of Life, that it does not contain nouriſhing Particles enow for their Subſiſtance; and has the ſame Effect upon their Bodies as they would find in the Receiver of the Air-Pump, if the more heavy Parts of the Air were drawn out: So likewiſe the *Animals* of the Land cannot inhabit the Water without Suffocation, any more than the Inha-

bitant

bitants of the Waters can live upon the Land, or in the ſeveral Stations of the Air.

As the *Fiſh* I am now treating of have their Motion and Paſſage from Place to Place by wimming only, it would be to tax Nature with an Indiſcretion to expect any other Parts bout them, but what are neceſſary for ſuch a Life and Motion. We plainly diſcover, by many Proofs, that the Water is to them of no more Uſe than Air is to Mankind. Every *Fiſh*, according to its reſpective Tribe, has a Food natural to it, as Land *Animals* have, and without that, the Waters are not ſufficient to maintain them.

The Food of Fiſhes is either *Plants* or *Herbs* f the Waters, *Inſects*, or other *Fiſh* ; it is for his Reaſon that they paſs from Place to Place certain Seaſons, in Search of their proper Food. I am informed that even *Whales* go in Troops from the moſt Northern Parts, as far the Coaſt of *Guinea*, and other Places near e Line, where the Sea is full of Weed, at a rtain Seaſon of the Year, and there couple as *nimals* do, and then in due Time return to eir Northern Station. The *Whale* is *Vivi-rous*, and ſuckles her Young, which, I am ld, never exceed 2 in Number. Some few ears ſince ſeveral 100 young *Whales* were iven on Shore upon the *Iriſh* Coaſt ; and of e *Whales* have been taken far *South* in the *Weſtern* Ocean, tho' *fiſhing for them* has been

long

long practiſed in the *Northern* Seas, as believing it their only Reſidence.

Mackarel, *Herrings*, and many other Kinds of *Fiſh*, have their Seaſons of coming upon our Coaſts, as well to ſeek their proper Food then in the Channel, and in our Rivers, as to lay their *Spawn*; and I have not heard that any of theſe Paſſing *Fiſh* have been found in our Seas but at the common Seaſons. It is likewiſe to be obſerved, that the *Fiſh* of *Paſſage* ſwim always in Shoals, and are as punctual to the Times of their *coming* and *going*, as the Temper of the Seaſon will permit: Sometimes a ſtrong Wind or cold Weather will keep them back 15 Days later than their uſual Time; and, on the contrary, I have known them come into the Channel and our Rivers a Fortnight ſooner than they uſed to do, when the Weather has been warm, or the Wind ſat to drive them in: But it is no Wonder that their Seaſon of *Paſſage* depends ſo much upon the Temper of the Air, ſeeing every Thing which is proper for their Food is equally depending upon the Weather. The Sea or River-Weeds muſt have a certain Temperature of Air to bring them forward; the *Inſects* of the Waters, *&c.* depend alſo upon the ſame Cauſe for their hatching; and if our *Paſſage-Fiſh* are *Fiſh* of Prey, the *Fiſh* they prey upon will not run before them, if they cannot meet with neceſſary Food.

As to the Time of *running* or *paſſing* of each particular Kind of *Fiſh*, it muſt not be expected that I ſhould give an exact Account of them; my Obſervations have not been ſufficient ro remark the Seaſons when the ſeveral Sorts of *Fiſh* come into our Rivers. But if we may believe the curious Obſervers of *Fiſh*, they have *two* Modes of Generation; the *Squameous* or *Scaley* Kind of them lay their *Eggs* or *Spawn* in ſhallow Water, and the *Milter* or *Male* covers it with a prolific Juice as ſoon as it is excluded from the Body of the *Female*; and when he Waters, by means of the Weather, become of a certain Temperature, the *Spawn* hatches at once into little *Fiſh*, which for a certain Seaſon ſwim and feed together in Shoals, not caring to mingle themſelves with the *Spawn* or young *Fry* of others, till they are capable of ſhifting for themſelves. It is remarkable, that the ſmaller they are, they delight in the ſhallower Waters, and as they gradually increaſe in Bigneſs make towards the Deep.

The *Cetaceous* Kind for the moſt Part are ſaid to couple; and in ſeveral Kinds of them we may plainly diſcover the *Male* and *Female* Parts of Generation. Some of them are *Oviparous*, and others *Viviparous*.

The Number of *Spawn* laid by ſome *Fiſh* is almoſt incredible: The *Roe* of the *Cod-Fiſh*, for Example, in the Space of a *Cube* of ¼ of an Inch, contains 250 *Eggs*; and according to that Proportion, the whole muſt contain about 1,000,000. The great Mr. *Lewenhoek* tells us, that in the Space of a ſmall Sand of the *Male-Seed* of the *Cod-Fiſh* there are above 10,000 *Animalcula.* Now ſuppoſing that every *Egg* or *Spawn* of a ſingle *Cod-Fiſh* ſhould come to Perfection, and that in 5 Years Time every one of thoſe *Fiſh* ſhould be capable of producing others, ſuppoſing only half of them *Females,* the Increaſe of them would then be 5,000,000,000; and 5 Years afterward, by the ſame Reckoning, there would be an Increaſe of about a thouſand Miriads of Miriads; which Increaſe, in the Space of 10 Years, from one ſingle *Fiſh,* would give us room to ſuppoſe, that in 1000 Years, at that rate, the *Cod* only ſo propagated would fill up more Space than the whole World contains. But we are not to imagine that this vaſt Number of *Spawn* or *Eggs* can all of them be prolific, nor is it without the Hazard of being devoured by other *Fiſh,* or of being deſtroyed by other Accidents: If only a 40th Part of that which is laid annually in the Sea comes to good, the Waters would hardly be able to contain its Produce. Nor are the *Fiſh* of the Rivers and Lakes leſs prolific, conſidering their Proportion. A *Carp* does not ſpawn leſs than 20,000, and perhaps a *Tench* ½ as many; and I believe we may lay it down as a general Rule, that the more Enemies a *Fiſh* has to itſelf and its Increaſe, ſo Nature has taken Care to provide it with ſuch a Capacity of increaſing, or propagating its Species, that there is a due Allowance to make good all Loſſes that may happen.

It is my Opinion, that moſt Kinds of *Fiſh* are partly dictated by Nature to ſhift their Place about *Spawning* Time, as well for the Preſervation of their young ones as for the Sake of their Food. And it is obſervable, that the *Paſſing-Fiſh*, after they have ſpawned, find out ſome other Station, perhaps becauſe they would avoid thoſe *Fiſh* which would prey upon them, if they were to ſtay in the ſame Place.

The Forms and Texture of the Parts in *Fiſh* are as various as what we find in the *Vegetable* Kingdom: Every one is provided with neceſſary Parts to defend itſelf againſt, or to avoid, its Enemies. The *Flying-Fiſh* has Fins of ſo great a Length, as to do the Office of Wings in the Air for a certain Time, till they become dry, as well as ſerve them for Conveyance from Place to Place in the Waters: By this Means they avoid the *Dolphins*, who purſue them for Prey. One of theſe Sort I have delineated in *Plate* VIII. Fig. I. taken from that of our Royal Society. The *Sword-Fiſh* and *Saw-Fiſh* I have alſo taken the Figures of, (from thoſe at *Salter*'s Coffee-Houſe at *Chelſea*) to ſhew what Weapons Nature has provided them with for their Defence; which makes me ſuppoſe that they are not without Enemies to prey upon them, notwithſtanding they ſometimes meaſure 6 Feet in Length. And, to ſet aſide the fabulous Account of the *Syren* or *Mermaid*, I have likewiſe, in the ſame *Plate*, added the Figure of the true *Mermaid-Fiſh*, as it is now preſerved in Mr. *Salter*'s Collection of Rarities.

The *Orbis Echinatus*, and *Lanthorn-Fiſh*, are alſo naturally guarded with *Spines* which cover their whole Bodies, ſo that no kind of *Fiſh*, be they ever ſo voracious, dare attempt them. Nor is the *Perch* without its *Spines* in the back Finn, which it can raiſe up at Pleaſure for its Defence, when its Enemy draws near.

But it is not only by theſe natural Arms or Weapons that *Fiſh* preſerve themſelves, or their *Spawn*, from the *Fiſh* of Prey; they have likewiſe a natural Cunning, which furniſhes them with Contrivance to make themſelves Neſts or Caſes of Shelter for themſelves and their *Spawn*; an Inſtance of which I have lately been agreeably furniſhed with by the learned *John Hall*, Eſq; Serjeant at Arms, who made me a Preſent of a *Tickleback*'s Neſt, which he obſerved the Structure of from near the Time of its Beginning, till it was brought to the Perfection it is in the Figure: It is compoſed of little *Fibres* of *Roots*, ſo placed together, as to leave an hollow *Tube* in the Middle, which I ſuppoſe was rather compoſed to lay the *Spawn* in, than for a Lodgment for the *Fiſh* itſelf; for the *Tickleback* has a ſharp Thorn in its back Fin, which I ſuppoſe is ſufficient to defend it from *Fiſh* of Prey; but as they always live in the ſhalloweſt Water, ſo their *Spawn* would be too much expoſed to the

he *Swallows*, or other Birds, which delight to
e near the Waters, was it not to be defended
rom them by ſome ſuch like Covering. About
he End of *May*, or Beginning of *June*, is the
ime when theſe little Builders are at Work.
nd ſince we have this Inſtance of the Con-
ivance of one Kind of *Fiſh* for its Preſervation,
r the Preſervation of its Young againſt Ene-
ies, we may as reaſonably conjecture that o-
her Sorts of *Fiſh* have their reſpective Methods
f building Neſts or Shelters for their Security,
hich is no more than all Birds do, tho' after
ifferent Manners. And indeed we do not find
ny living Creature whatſoever that has not
me Senſe or other which guides it to the Stu-
y of its Preſervation: Even the *Cados-Worms*
ave each reſpectively, according to its Tribe,
Mode of making its Caſe or Lodgment after
particular Manner, to defend themſelves from
e *Fiſh* which are very voracious of them. *One*
ind makes its Covering of the Points of *Ruſhes*,
nother of ſmall *Shells*, and a *third* of fallen
eaves, which, by Means of a *Viſcous* Matter,
ey glue and cement together in ſuch a Man-
er that it is hard to ſeparate them. The three
inds which I here mention, are taken from
e curious Cabinet of Mr. *Dandridge* in *More-*
lds, where there are many other Sorts of them
mong his numerous Collection of *Engliſh In-*
ts.

Fiſh ſeem to enjoy the Power of *Senſation* as
erfectly as any other *Animal*. Their Sight
can-

cannot be diſputed, and even ſeems to excee the Sight of many *Animals* for its Quickneſs and I ſuppoſe their Taſting and Smelling are no leſs perfect; for we find moſt Kinds of *Fiſ* will take one Bait rather than another, altho they are compoſed of ſeveral Ingredients, an have no regular Form; which ſeems to determine that either their Taſte or Smelling is mor pleaſantly affected by one thing than another But indeed I do not find that the curious Obſervers of *Fiſh* are of Opinion that they wan any *Senſe* but that of *Hearing*; and even they do not determine whether that Senſe is abſolutely wanting or not: But if I may be allowe to judge from an Experiment I have made upo *Carps* in ſeveral Places, I believe it will be allowed that they enjoy that *Senſe* as well as the reſt

At *Rotterdam*, in a Garden belonging t Mr. *Eden*, a very curious Gentleman, I ha the Pleaſure of ſeeing ſome *Carps* fed, which h kept in a Mote of a conſiderable Extent; th Occaſion of my ſeeing theſe Creatures, wa chiefly to ſatisfy me that they were capable o *Hearing*. The Gentleman having filled hi Pocket with *Spinach-Seed*, conducted me t the Side of the Mote, where we ſtood mut for ſome Time, the better to convince me tha the *Fiſh* would not come to us till he calle them. At length, being deſirous to ſee the Event, he called in his uſual Way, and immediately the *Fiſh* gathered together from all Part of the Mote in ſuch Numbers, that there wa hardly

ardly room for them to lie by one another,
nd then he flung ſome *Spinach-Seed* among
hem, which they devoured very greedily. This
lone would have ſatisfied me that *Fiſh* had the
enſe of *Hearing*; but upon relating the Story
o ſome curious Gentlemen, I was told, that at
ir *William Bowyer*'s, near *Uxbridge*, there is a
ond of *Pikes* or *Jacks*, which they call toge-
her at Pleaſure, and I think is more ſurpriſing
han what I have mentioned of the *Carps*; for
he *Pike* is held to be a more wild, untameable
iſh than the *Carp*; and as it is a *Fiſh* of Prey,
has been thought impoſſible to civilize it, or
ake it any way familiar with Mankind. There
re indeed many Inſtances of *Carps*, and *Tench*,
hich will come of their own accord, at certain
imes, to ſome particular Part of a Pond to be
d; but I ſuppoſe they have been trained up
om the firſt Year to feed at one Corner of the
ond rather than at another; that is, when
ne Part of a Pond has been continually ſup-
lied with ſuch Ingredients as are proper Food
r them, either by means of an accidental Drain,
r deſignedly.

I have this Year taken a large Parcel of
oung *Fiſh*, juſt after hatching from the *Spawn*,
d have kept them near 3 Months in Earthen
ans, with a little Earth at the Bottom; the
iſh are of ſeveral Kinds, and do not only thrive,
t are now ſo familiar, that upon my Ap-
oach they come in Shoals to the Side of the
ans to be fed: The firſt Thing I fed them
with

with was Wheat Flower ſcattered upon the Water, for the *Fiſh* were then ſo ſmall that they could not ſwallow any Thing larger than a Grain of Flower: At the ſame Time I gave them freſh Water from the *Thames*, which I ſuppoſe was not without ſome nouriſhing Parts in it; but now they are large enough to feed upon ſmall *Inſects*, and little Bits of Paſte made of Flower and Water, which they readily catch at, as ſoon as I fling it in. Towards the Winter I deſign to inlarge their Bounds, and I ſuppoſe then, with a little Care, I may keep them to their familiar Way of Feeding, where and when I pleaſe: For I find it is with *Fiſh*, as it is with *Birds* or other *Animals*, that the beſt way to civilize them, is to have the Management of them when they are very young, and by that Means they may be brought to do any Thing within the Bounds of their Comprehenſion, or that is agreeable to the Structure of their Parts; and their Memory is ſo conſtant, that, after this early Impreſſion, they hardly ever forget it. But the Docility of *Fiſh*, I believe, does not exceed what I have here related.

To conſider the Parts of *Fiſh* more particularly, we may obſerve that every Kind of *Fiſh* has its Jaws framed for the taking and macerating of its particular Sort of Food: Such as feed upon *Weeds* and *Inſects* have ſeldom any Teeth; but ſuch as prey upon other *Fiſh* have 1, 2, or more Rows of Teeth, for the better grinding their Food. The Gills of the *Cod-Fiſh* are guarded with Tooth-like Bones, which I ſuppoſe are no leſs contributing to Maceration than Teeth themſelves. The *Fins* are in Proportion to the Bodies of the *Fiſh* they relate to, and ſerve as Oars to row them from Place to Place, and raiſe them to any Height, or ſink them to any Depth in the Waters, while the finny Part of the Tail ſerves them as a Rudder to guide their Courſe. And for the more eaſy bending of their Bodies, their Back-bone conſiſts of very ſhort *Vertebræ*, ſo joined together, that their Tail may be eaſily bent up to the Head; and that ſuch bending of their Bodies may meet with no Obſtruction from their outward Coat, the *Scales* are ſo regularly placed in Rows one over another, and covered with ſuch a *viſcous* Matter, that they give way without Difficulty to the Motion of the *Fiſh*'s Body, and ſlide with Facility thro' the Waters.

The *Scales* of *Fiſhes* are as remarkably different, as the *Fiſhes* are various which have them for their Covering; and many of them, being examined with *Microſcopes*, are of very ſurpriſing Figures, ſome of them not unlike the *Shells* of *Pectunculæ*. All *Fiſh* indeed have not *Scales*, but ſuch *Skins* as are of a Leather-like Subſtance, and *viſcous* on the Out ſide; and I think this laſt Kind are moſt of them, if not all *Viviparous*, bringing forth their Young perfectly formed. I am aſſured by many Fiſhermen, that they frequently take at the *Buoy of the Nore*, about *Chriſtmas*, a *Fiſh* which they call a *Coney-Fiſh*, ſomewhat like an *Eel*; and at *that* Seaſon they are full of young ones, alive, and very nimble in their Motion, and I am of Opinion, at that Seaſon of the Year, which is the Time when *Eels* do *bed*, or *lay* themſelves up in the Mud, we might diſcover the Manner of their Breeding.

The Share of Life which ſome *Fiſh* poſſeſs is very remarkable, and is ſomewhat like that we obſerve in ſome *Inſects*: The *Eel*, for Example, being cut to Pieces, maintains Life and Motion, for ſeveral Hours, as if every *Muſcle* of its Body enjoyed a diſtinct Soul, or Spring of Motion whereby it lives, till the Part wanting a Supply of Nouriſhment is forced to ſubmit. And this is nearly the ſame in *Plants*, which have in every diſtinct Part of them (abſtracted from the Body) a Power of vegetating, and producing every particular Part which may be found in a full grown *Plant* of the ſame Kind they were taken from. A *Carp* is likewiſe poſſeſs'd of a very ſubtle kind of Life, and will move vigorouſly ſeveral Hours after the Inteſtines are taken out of its Body; and I have even ſeen one of its Fins move a conſiderable Time after it has been over the Fire in a Stew-Pan; but I have not obſerved whether the Heart will beat after it is taken out of the Body, as that of an *Eel* will do, with regular Motion, for above an Hour. I ſuppoſe that *Fiſh* are generally long-lived, and that *Carps* eſpecially will live above 100 Years: For in ſome large Pools or Fleets (as they call them) which have not been fiſhed or looked after in the Memory of Man, there have been *Carp* taken near 3 Feet in Length; and it is very rare to find a dead *Fiſh* in any Pond, unleſs it has been killed by ſome Wound or other Accident.

Next to an *Eel* I believe a *Carp* will live the longeſt of any *Fiſh* without Water; for it is common to tranſport them alive in Panniers, with Wheat-Straw, 40, or 50 Miles; and I once had ſome *Carp* that lived near 30 Hours without Water. I cannot help obſerving in this Place what I have often heard of the *Herring*, that it dies as ſoon as it is taken out of the Sea, becauſe I can affirm the contrary from my own Knowledge. In 1717, being in Company with my worthy Friend *Tho. Balle*, Eſq; and ſome other Gentlemen of *Devonſhire*, at the Drawing of a Sein or Net, among other *Sea-Fiſh* we caught a large *Herring*, which lived in my Pocket near half an Hour: This gave me a Thought of contriving a Method of preſerving ſome of the ſmaller Kinds of *Sea-Fiſh* alive, which would be very agreeable to the Sight, and as pleaſant to the Palate as if we were to dreſs them freſh taken out of the Water, when they could have no immediate Opportunity of getting them immediately out of the Sea.

Were we near enough to the Sea, and upon a Level with it, we might make little Store-Ponds to be fed with the Tides, which would ſerve to maintain ſome Kinds of *Sea Fiſh*, eſpecially if the Water in thoſe Ponds was always kept in Motion; for we find by Experience, the Motion of the Water is as material as the Saltneſs of it to preſerve Life in the *Fiſh* of the Salt-Water Race. Witneſs the Method the Fiſh-Women in *Holland* take to keep *Plaice* and ſome other Fiſh alive in Tubs, by moving the Water continually with Paddles, till all their *Fiſh* is diſpoſed of; for if they were to let the Water ſtand quiet for a few Minutes, the *Fiſh* would die: Therefore to keep Water continually moving in the Salt Ponds which I here propoſe, we might place a Couple of Wheels with Trenchers, like thoſe in common Water-Mills, to be turned by the Flux and Reflux of the Waters, and by their Motion produce a continued Agitation in the Water of the Ponds; or elſe, where we have the Benefit of a River to turn a Wheel continually, we might make a Baſon to hold a ſmall Quantity of Water, by adding to it one fortieth Part of common Salt, *i. e.* a Pint, or Pound of Salt to 39 Pints, or Pounds of Water. Sir *Hans Sloane* kept a *Turtle* or *Sea Tortoiſe* a long Time in Water prepared after this Manner.

But to return to my Remarks upon the Degree of Life in *Fiſh*, we may obſerve that the *Flounder*, and many others, will live a long

Time after their Bowels, and more noble Parts, re taken out of their Bodies, which is more han we can obſerve in any of the *Land Animals* or. *Birds*; for in them, as ſoon as the Heart is taken from its original Station, a Struggle or two finiſhes their Life; which hews plainly that Circulation of Juices in different Creatures is not always promoted by the ame Cauſe, or performed in the ſame Manner. For no Creature can live any longer than their Juices circulate; and every one allows, that in *Land Animals* the Heart is the immediate Cauſe of Circulation.

It may perhaps be expected that I ſhould be nore particular in this Account of *Fiſh*, and hat I ſhould deſcribe the ſeveral Kinds of them; ut that is not my Deſign in this Work; my Buſineſs is to give only a general Account of hoſe Remarkables in the Creation, which I know myſelf to be Fact, and to drop ſuch Hints as may lead the Curious to farther Obervations, in order for them to frame right Ideas of the Degrees of Life and Motion in the everal Particulars of the Creation. We may ndeed obſerve that there are *Whales* of 21 Feet ong, and *Fiſh* of all Proportions from that Length to an Inch only: And that in ſome Lakes there are Kinds of *Fiſh* which are not erhaps found elſewhere: That the enormous Bulk of the *Whale* exceeds all other Creatures pon Earth; and the Smallneſs of the *Tickleack* is inferior to any Kind of *Bird* or *Quadru-*

pede yet diſcovered. But was I to relate ever Thing I have heard concerning *Fiſh*, or othe living Creatures, I might ſwell this to a larg Volume, and make myſelf accountable to th World for a thouſand Falſities. Indeed wha Informations I have from ſome particular Gentlemen, who give me leave to back their Relations with their Names, I gladly receive, an publiſh to the World as ſo many Inſtances o their generous Spirits and Curioſity. I confeſ that I have not read much upon this Head, bu avoided thoſe Books which treat of the Subjec of this Work, as much as poſſible, leſt I ſhoul be too much biaſſed by the Narrations of Authors, who themſelves might have been impoſed upon. The great *Willoughby* indeed ha given us undoubted Truths in his *Treatiſes* o *Birds* and *Fiſh*, which are generally allowe the beſt Inſtructors for ſuch as are diſpoſed t ſtudy the Structure and Nature of thoſe Creatures; to which I refer my Reader. I ſhal now proceed to ſpeak of thoſe *Quadrupede* which are the neareſt related to the *Scal* Tribe.

Explanation of the Figures relating to Chap. IV

PLATE III.

Fig. I. *The* Muſcle.

Fig. II. *The* Scallop, *whoſe Motion is perpendicular.*

Fig, III. *The* Lobſter *lying in its natural Poſition.*

Fig. IV. *The large* Sea-Crab.

PLATE IV.

Fig. I. *The Upper-ſide of the* Star-Fiſh *moſt common upon our* Engliſh *Coaſt.*

Fig. II. *The Under-ſide of the ſame* Fiſh.

Fig. III. *The* Shell-Fiſh *called the* Sea-Horſe, *found upon the Coaſt of* Italy; *taken from the Royal Society.*

Fig. IV. *The* Turtle, *or* Sea-Tortoiſe, *clothed in* Shell, *the firſt of the finny Race*; *drawn from Mr.* Salter's *Collection at* Chelſea.

PLATE V.

Fig. I. *The* Sword-Fiſh.

Fig. II. *The* Saw-Fiſh.

Fig. III. *The* Mermaid, *or* Syren.

N. B. *All this Plate taken from Mr.* Salter's *Collection.*

PLATE VI.

Fig. I. *The* Orbis Echinatus; *from Mr.* Salter's.

Fig. II. *The* Whiting.

Fig. III. *The* Silver Eel, *whereby the Difference between the* Smooth Fiſh *and the* Squameous *Kinds may be obſerved.*

PLATE VII.

Fig. I. *The* Roach, *which may ſerve to gi*
a general Idea of the Squameous *or* Scal
Fiſh.

Fig. II. *The* Flounder, *or firſt of the fl*
Fiſh. *In this Kind it is remarkable that th*
Males *have their Mouths on the* right *Sides*
their Bodies, and the Females *on the* left.

Fig. III. *The* Thornback, *ſhewing its upp*
and lower Sides.

PLATE VIII.

Fig. I. *The* Flying-Fiſh; *from the* Roy
Society.

Fig. II. *The Neſt of the* Tickleback *obſerve*
by Mr. Hall.

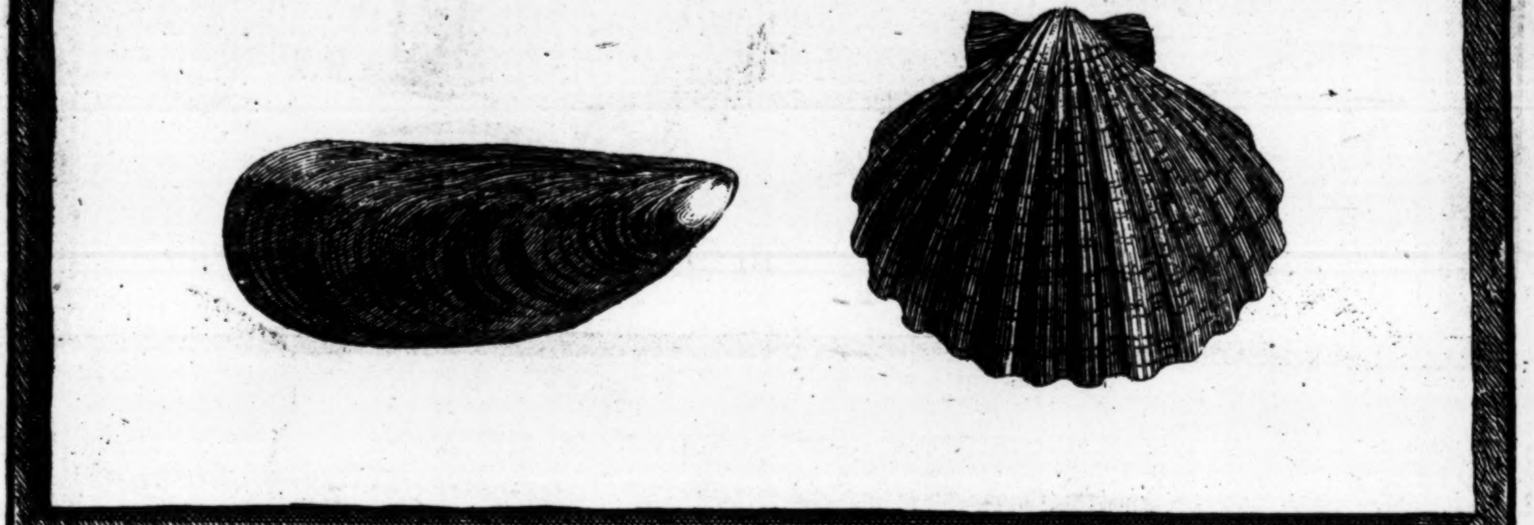
Fig. III. *The Neſts or Caſes of* 4 *ſever*
Kinds of Cados-Worms *found in the Waters.*

CHAP. V. and VI.

Of SERPENTS, *the* CROCODILE, LIZARD,
CAMELION, *and others of the* Scaley *Tribe*
which are Amphibious, and Inhabitants of th
Land; *and of* FLYING LIZARDS, &c
which ſeem to be the immediate Paſſage betwee
the Fiſh *and* Bird *Kind.*

AS I have diſcourſed of ſuch *Creatures* o
the *Waters* as are generally clothed i
Scales, I can no where ſo properly introduc

the



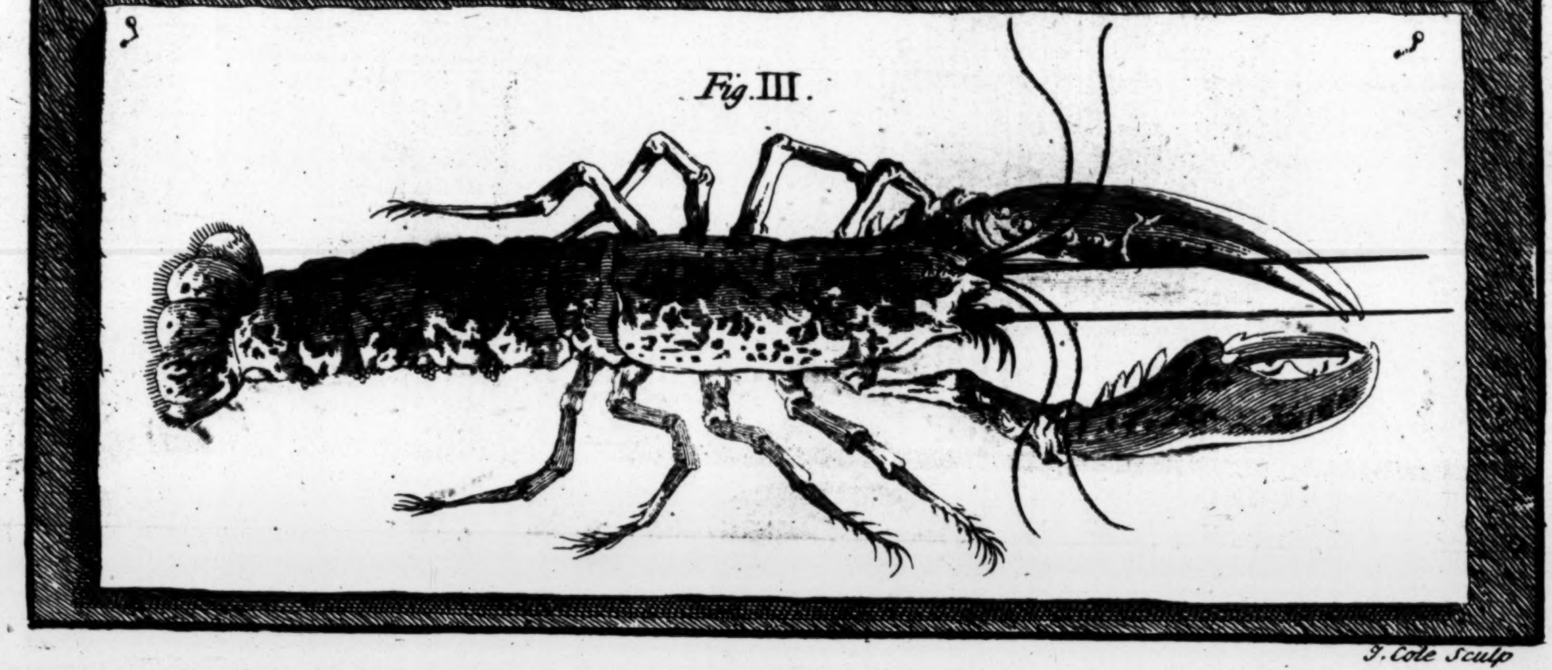
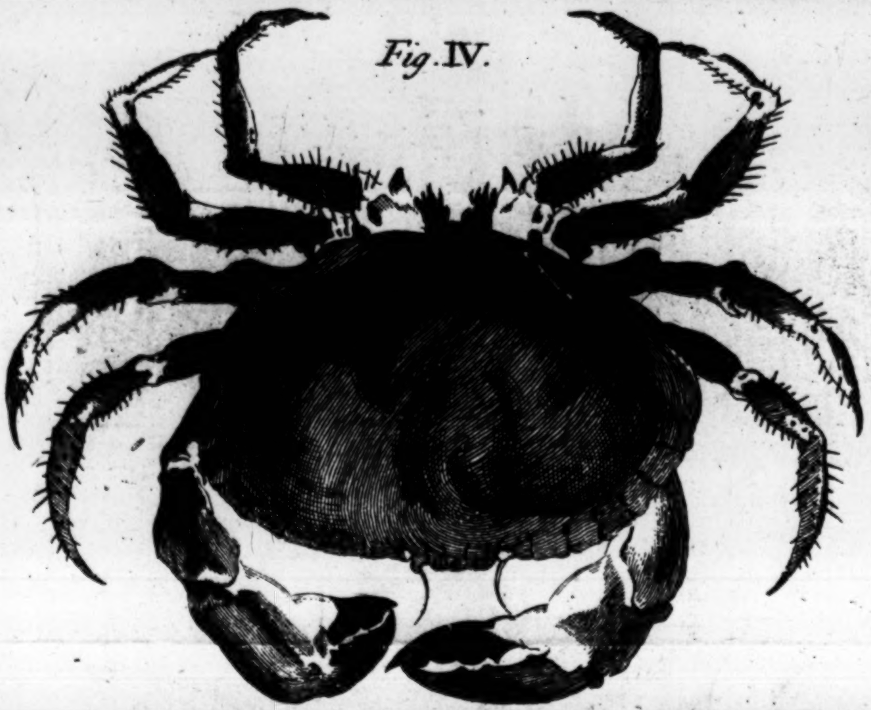


Fig. III.

J. Cole Sculp

Plate. III.

Fig. IV.



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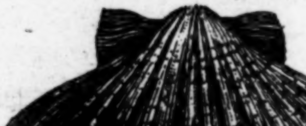

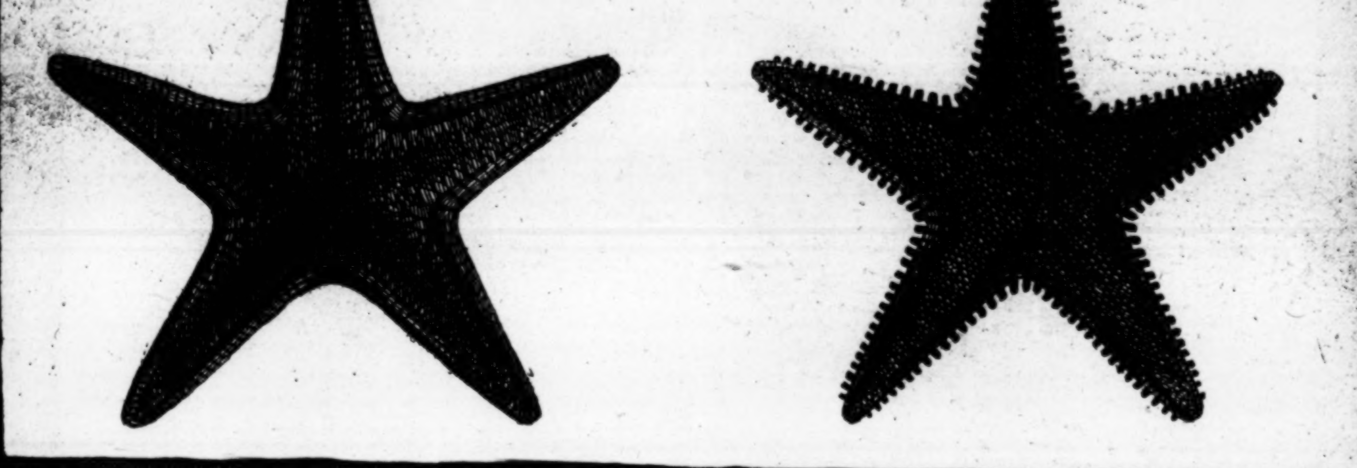

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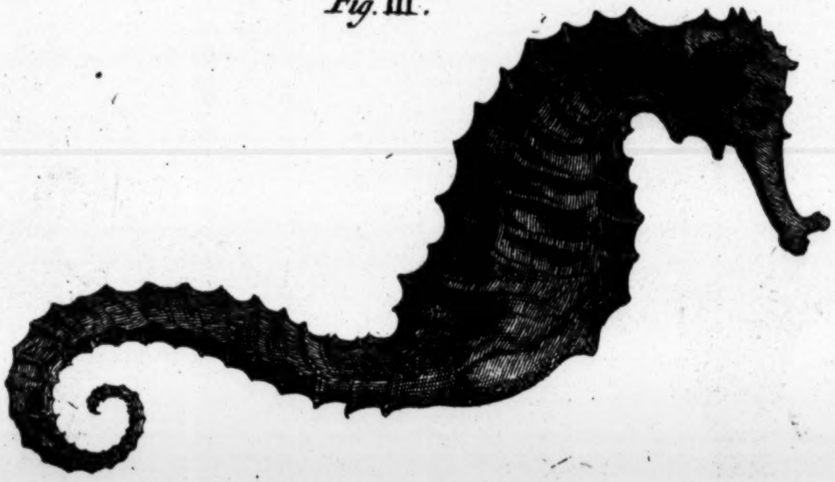
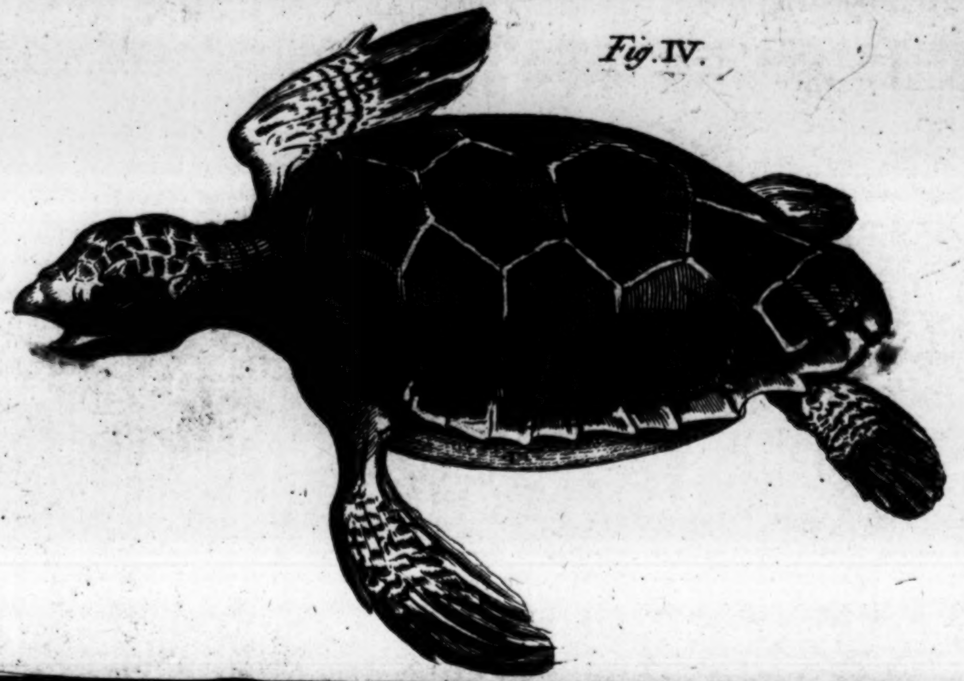


J. Cole Sculp

Plate. IV.



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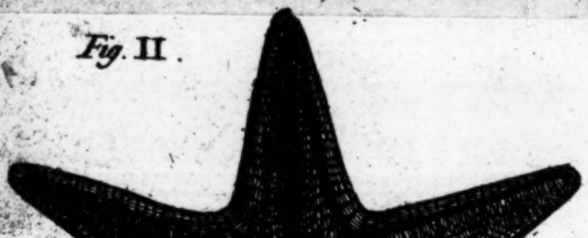

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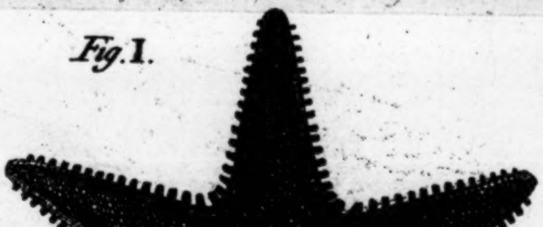

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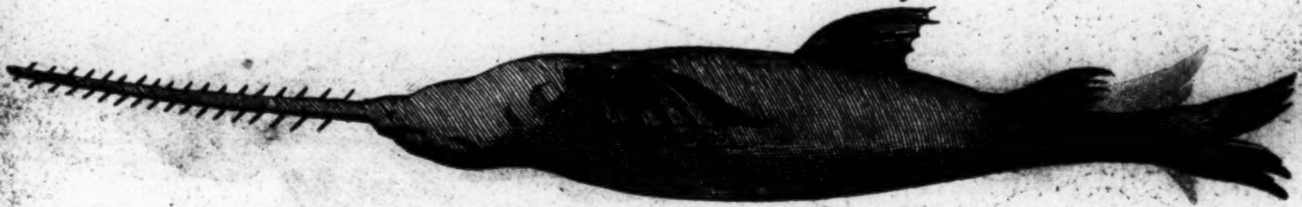

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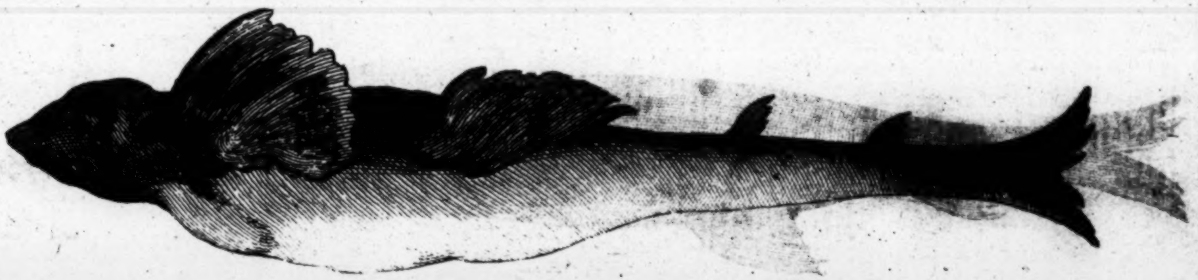

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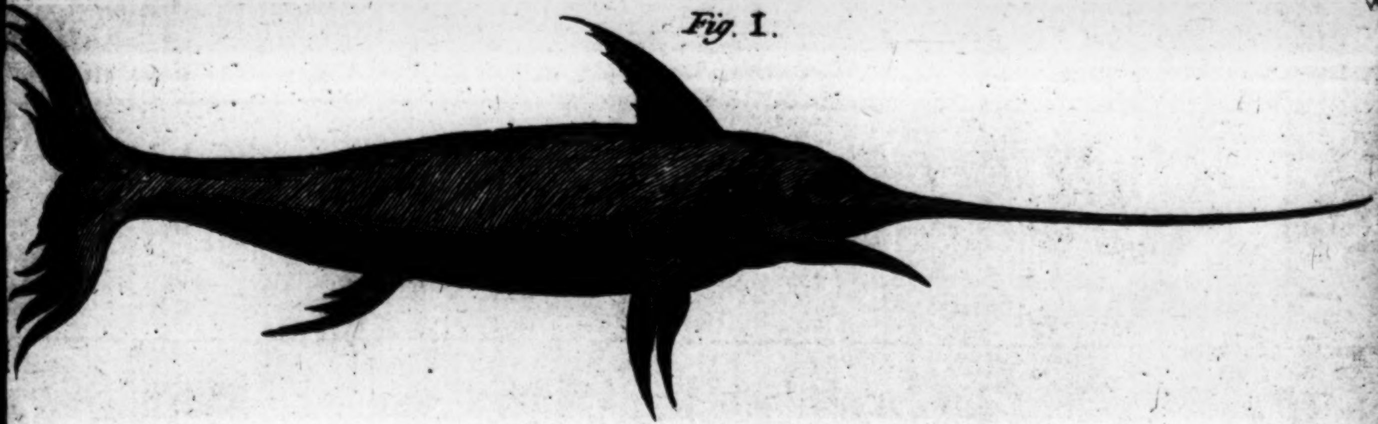

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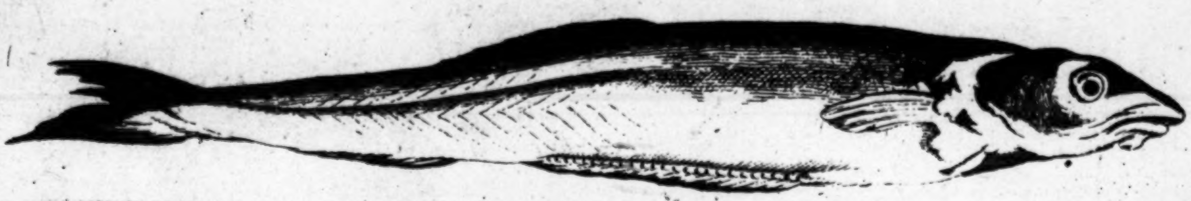

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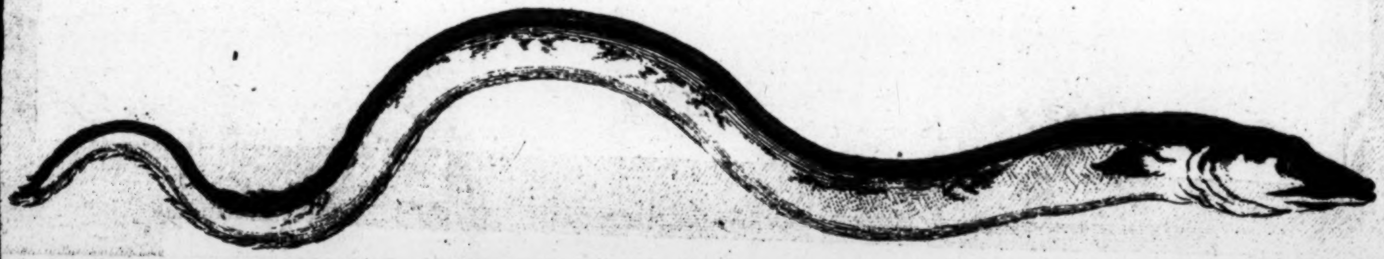
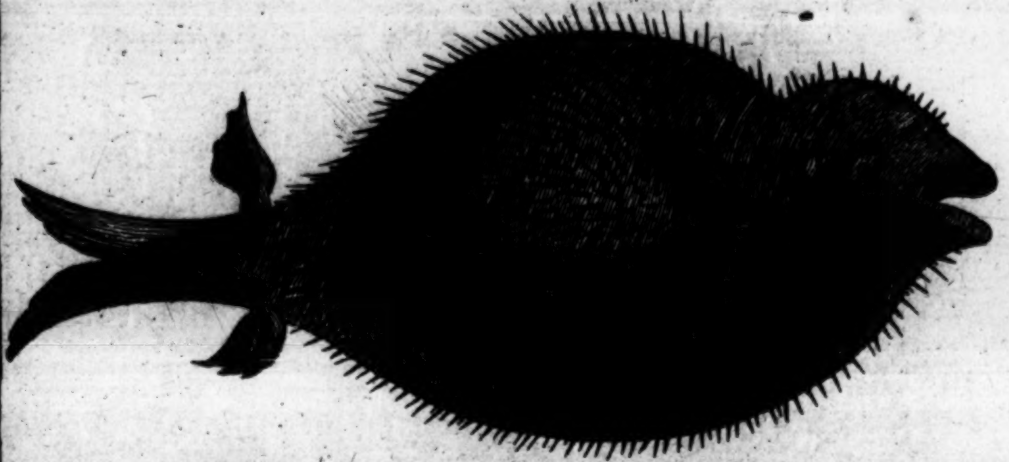


Plate VI.

Fig. I.



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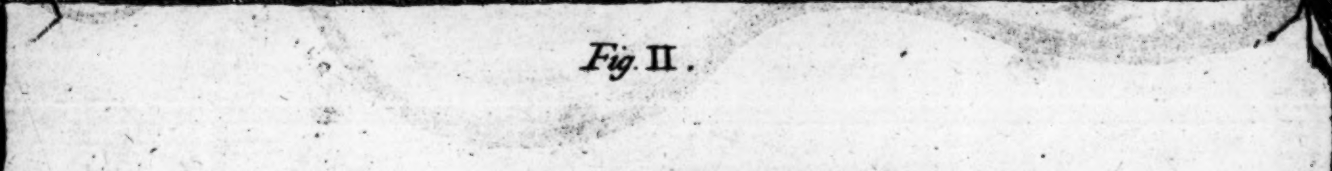

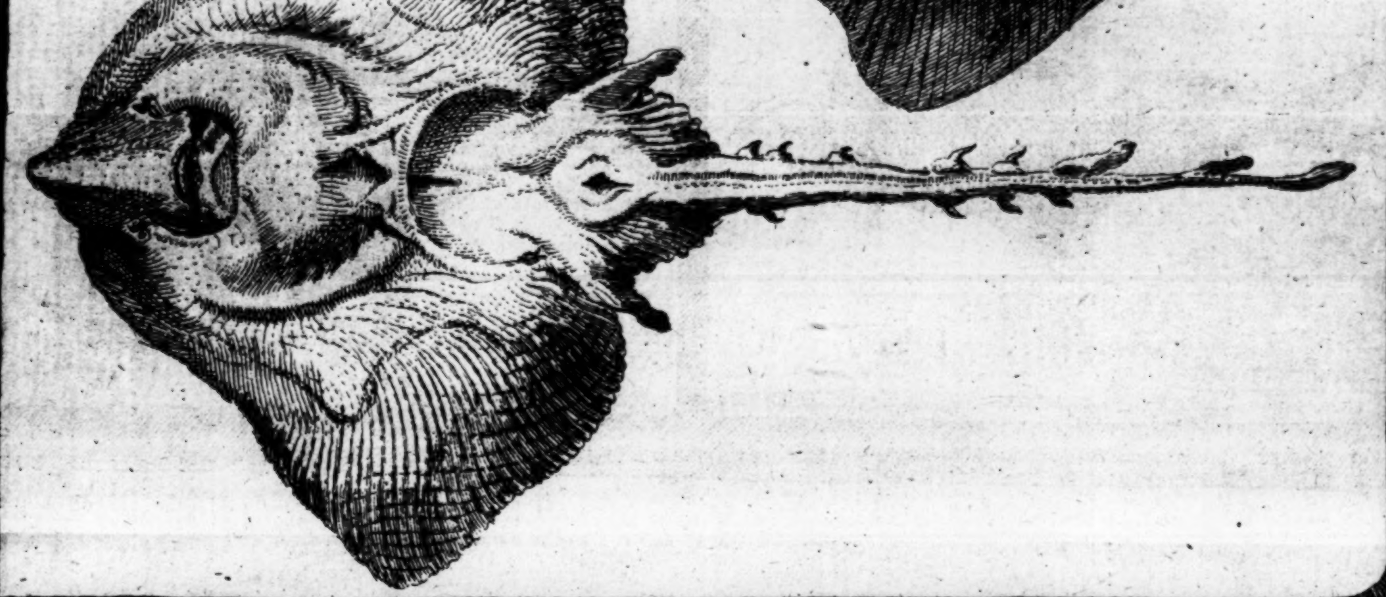

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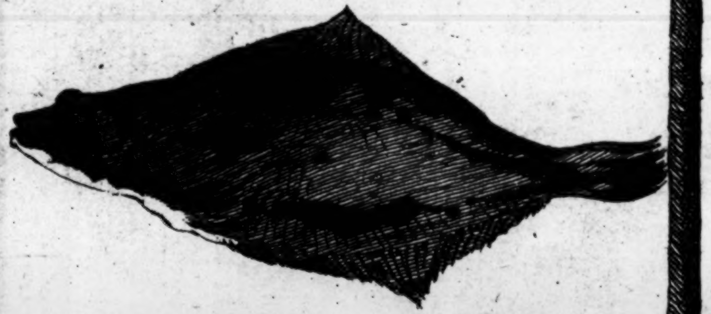

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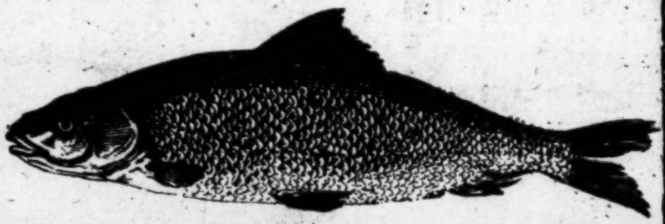

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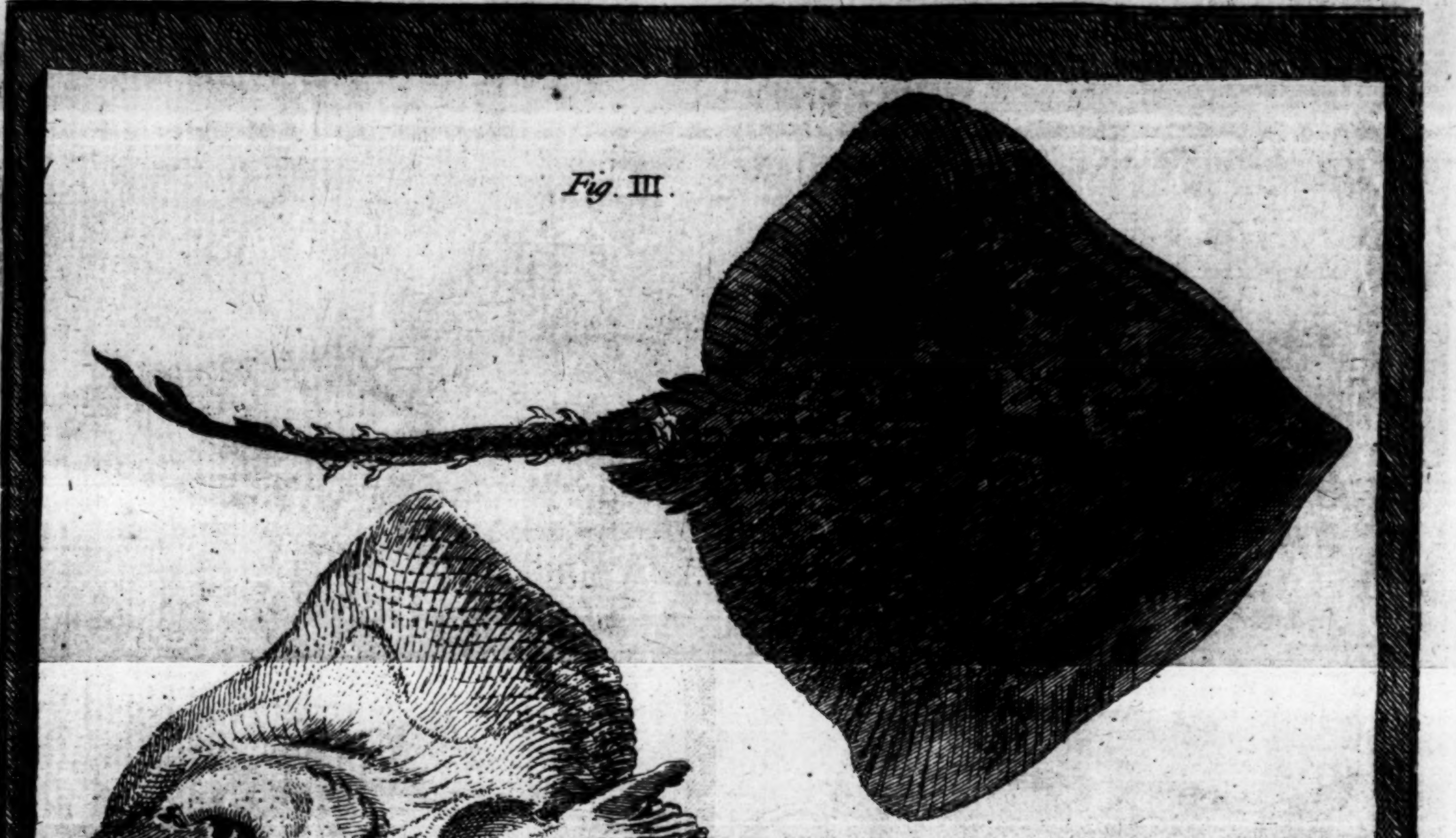

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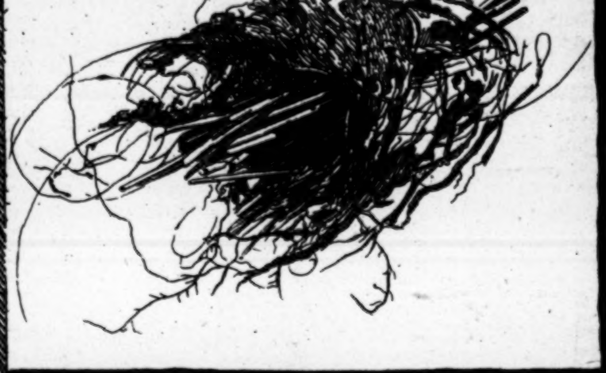

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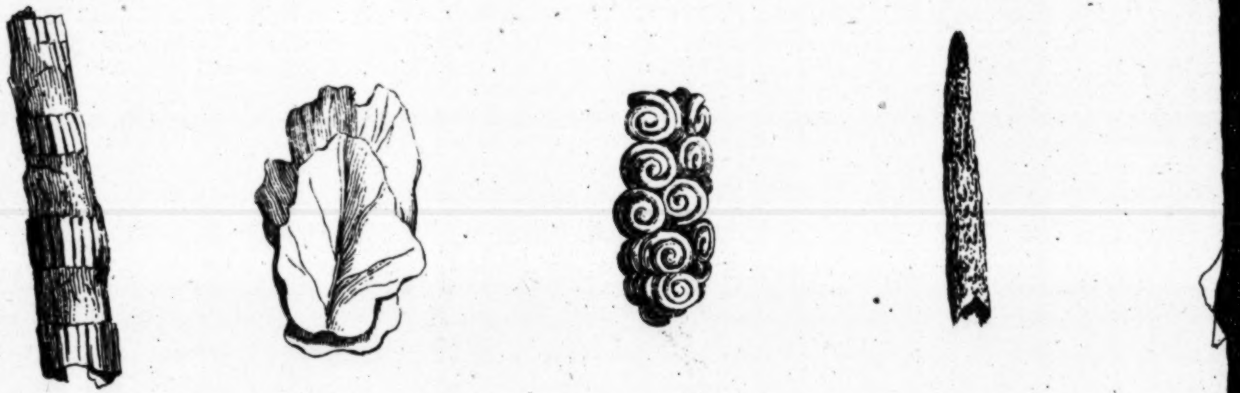


J. Cole Sculp.

Plate VIII

Fig. I

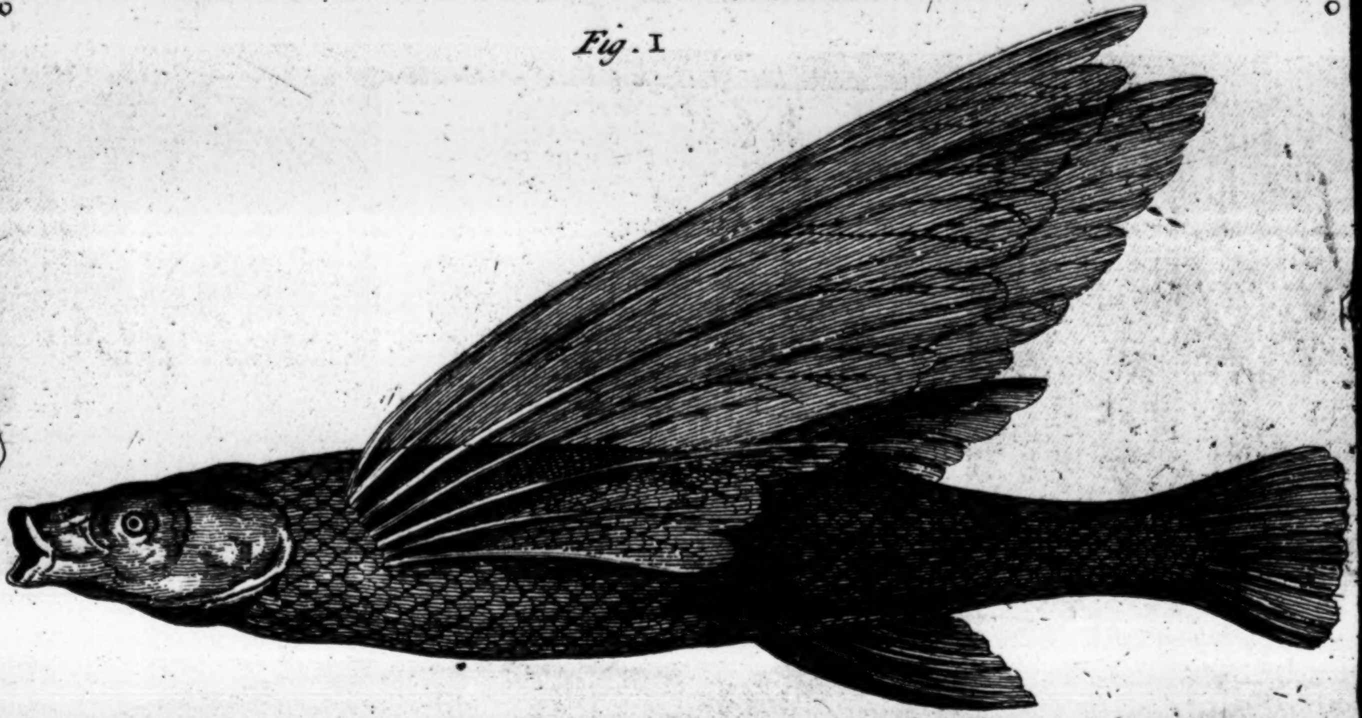


Fig. II

the Race of *Serpents*, *Snakes*, &c. as in this Place: Theſe ſeem to poſſeſs many Particulars found in *Fiſh*; as the Manner of placing their *Scales*; their *Eel*-like Motion; but above all, their Degree of Life. As I have taken notice above of the extraordinary Motion of every *Muſcle* of an *Eel*, and ſome other *Fiſh*, after they are cut to Pieces; ſo ſuch Motion is no leſs remarkable in ſome *Snakes* and *Serpents*, after their Bodies are divided into ſeveral Parts. And the Food likewiſe of our common *Snakes* is much the ſame with that of our River *Eels*, they both feeding upon *Frogs*, *Toads*, and ſuch like.

Of this Race I do not find above 3 ſorts in *England*, *viz.* the *Snake*, the *Viper*, and the *Slough-Worm*. The firſt is an harmleſs Creature, as far as I can obſerve, though many believe the contrary: For this Year I have had ſeveral alive, which have been familiar about the Houſe, without doing any Hurt; though ſome have taken them into their Boſom. I have heard that what Poiſon they have lies about their Tongue, but that they loſe it the firſt Dart they make at any Thing they are angry with, and can never recover it again till they get to Water: But if it was ſo, I believe People would hardly venture to take them up careleſly in the Fields, as I have ſeen ſeveral Times. The *Viper* indeed has a *deadly* Poiſon lodged in little Bladders about the Root of its Fangs; but his whole Body beſides is a Dainty, eaten very frequently. The learned Dr. *Tyſon* tells us in his Account of the Diſſection of a *Rattle-Snake*, *Phil. Tranſ.* No. 144, that the *Male Viper* has 4 *Penes*, agreeing in moſt Particulars with the *Penes* of the *Male Rattle-Snake*, which are likewiſe 4 in Number, although the *Females* of both Kinds have each of them only 2 *Uteri* for receiving them. He conjectures that 2 of theſe *Male* Parts enter at one Time into one *Uterus*, and ſpread themſelves like the *Pythagorean* Y, that they may the better and more firmly be retained there till they have performed their Duty. He tells us that both the *Rattle-Snake* and the *Viper* are *Viviparous*; but the common *Snakes* we all know are *Oviparous*; their *Eggs* being frequently found in Dunghills.

The ſame *Gentleman* gives us a long Detail of the ſeveral Parts *External* and *Internal* of the *Rattle-Snake*, which he diſſected before the Royal Society, in *January* 1682-3, illuſtrated with many extraordinary Obſervations, to which I refer, as well as the curious Cuts which he has prefixed. In Plate IX. of this Work I have given a Cut of one of thoſe *Rattle-Snakes*, now in the Repoſitory of our *Royal Society*; and in the *ſame Plate* I have given likewiſe a Figure of *another* Kind of *Serpent*, as well to ſhew the different Frame of the *Heads* of various Kinds of *Serpents*, as to give my Reader the Satisfaction of obſerving the ſurpriſing Variety of Colours, and different Methods of their Scaling.

In the Cabinets of the Curious we may find vaſt Varieties of the *Serpent* Kind; but I think none of them can be more remarkable than that preſented to the Royal Society by Dr. *Mead*, which is above 25 Feet long. The Body in the thickeſt Part, although it is now dry, meaſures about 10 Inches Diameter; and I believe is one of the largeſt Sorts produced in the *Eaſt-Indies*.

Immediately after this Race, follow the *Crocodile*, *Alligator*, *Lizard*, &c. which are covered with *Scales*, like the former, placed conveniently in the *Lizard* Kind, for the eaſy bending of their Bodies: The Shape of their Heads is agreeable to the Figure of the Heads in *Snakes*, and they are *Oviparous*; but for the Aſſiſtance of their Motion upon the Land, Nature has added to their Bodies 4 Branches or Legs a-piece. Their Habitation is partly in the Waters, and partly upon the Land: The firſt agreeing with the *Fiſh* Kind; and the latter, as well as the Legs they are endowed with, make them Partakers with Land *Animals*.

We have Accounts of *Crocodiles* and *Alligators* of above 20 Feet in Length; and I am of Opinion that ſome of theſe Creatures having been formerly in *England*, has given Riſe to the many fabulous Accounts, which have been handed down even to our Times, of *Dragons*; and this I the more readily believe, becauſe the Skeletons of ſome ſuch Creatures, or the Impreſſions of them in Stone, or other *Mineral*

Matter, have been dug up in ſeveral Parts of the Kingdom.

The *Lizard* Kind is very numerous; and I queſtion not but there is as great a Variety of them as there is of the *Serpent* Race. Upon *Hamſtead-Heath* I have obſerved a ſmall Sort of them of a *Browniſh* Colour, perching upon the *Furze* and *Broom* growing there; and I have heard of a ſmall *Green* Sort likewiſe in *England*, but have not ſeen it.

The *Water-Neutes* are almoſt of the ſame Figure, and are ſaid by ſome to be poiſonous; though I have handled them very often, without receiving any Injury from them. We have beſides theſe a larger Kind, found commonly in moiſt ſhady Places, which are *Black* on their Back, and have *Yellow* ſpeckled Bellies; and theſe likewiſe I do not find have any Venom in them. Theſe two laſt Kinds lay *Eggs* about eight or ten in Number, and the *Crocodiles* and *Lizard* Kind are ſaid to do the ſame; and none of theſe, as I can learn, either feed or ſuckle their Young, but leave them to ſhift for themſelves as ſoon as they are hatched. The Natural Hiſtorians have given us large Accounts of theſe Creatures, which I refer my Reader to for his further Satisfaction.

The *Camelion* is a Creature, whoſe Figure is near enough to thoſe of the foregoing Race, to accompany them in this Chapter; but its Life and Habitation is altogether upon the Land; its Skin is ſhagreen'd, like that of the *Dog-Fiſh*,

Fiſh, and tranſparent; ſo that ſometimes one may perceive through it different Colours, as its Body happens to be in a different State. This Creature has been reported to live upon the Air only; but thoſe among the Curious, who have kept them alive, tell us, that their chief Food conſiſts of *Flies*, which they catch by darting out their Tongue with great Quickneſs. All the *Animals* which I have yet mentioned in this Chapter are ſaid to ſleep, or are laid up in the Winter.

The Creature which ſeems to be next allied to the foregoing Race, is the *Winged* or *Flying Lizard*, whoſe Shape and Turn of Body, in many Reſpects, is like that of the ſmall *Italian Brown Lizard*, or that Sort found upon *Hamſtead Heath*: The *Winged* Part of it is in Subſtance much like the *Wing* of a *Batt*, but the Head is different from that of the *Lizard* Race; and the *Pouch* under the Throat I am told contains a poiſonous Matter. This Kind of *Flying Lizard*, which I have delineated in Plate IX. Fig. V. was preſented me by Dr. *Ruyſh* of *Amſterdam*, who received it with other Rarities from the *Eaſt Indies*: And the ſame Kind may be obſerved in the Cabinets of Sir *Hans Sloane*, Mr. *Vincent* of *Harlem*, Dr. *Ruyſh* and Mr. *Seba* of *Amſterdam*.

In the *Weſt Indies* there is another Sort of *Flying Lizard*, different in the Colour and Make of its Wings from the former; and inſtead of a Bag under the Throot, has a thin

Film or Skin hanging down, almoſt of th Shape of a *Myrtle Leaf.* This and the oth Kind is ſaid to be *Oviparous*; and in the Accounts Dr. *Ruyſh* gave me of them, it appea that they have each of them the Power of Fligh and generally perch upon *Trees*; which leads m naturally to treat of *Birds* in the next Chapte

Explanation of the Figures relating to Chapter V *and* VI.

PLATE IX.

Fig. I. *The* Rattle-Snake *from the* Weſt-Indies ; *taken from one of thoſe preſerved in th* Muſeum *of the Royal Society.*

Fig. II. *A* Weſt Indian Serpent ; *from th ſame* Muſeum.

Fig. III. *A* Lizard ; *from Sir* Hans Sloane's *Cabinet.*

Fig. IV. *The* Camelion ; *from the Royal Societ*

Fig. V. *A* Flying Lizard *from* Amboyna *in the* Eaſt-Indies ; *taken from Sir* Hans Sloane's *Cabinet.*

CHAP. VII. *and* VIII.

Of BIRDS *and* FOWLS ; *as alſo of the* BATT (or Flutter-Mouſe) FLYING SQUIRRELS, &c. *which ſeem to be the Paſſage between* Fowls *and four-footed* Beaſts.

I ſhall now treat of ſuch *Animals* as are clothed with *Feathers*, and in many Reſpects agree with the laſt mentioned *Animals*, which

Plate IX

Fig. II.

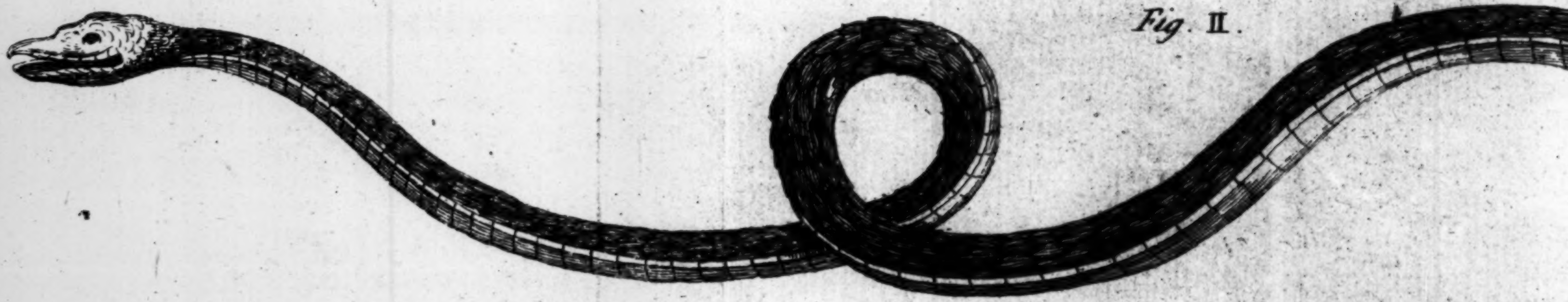
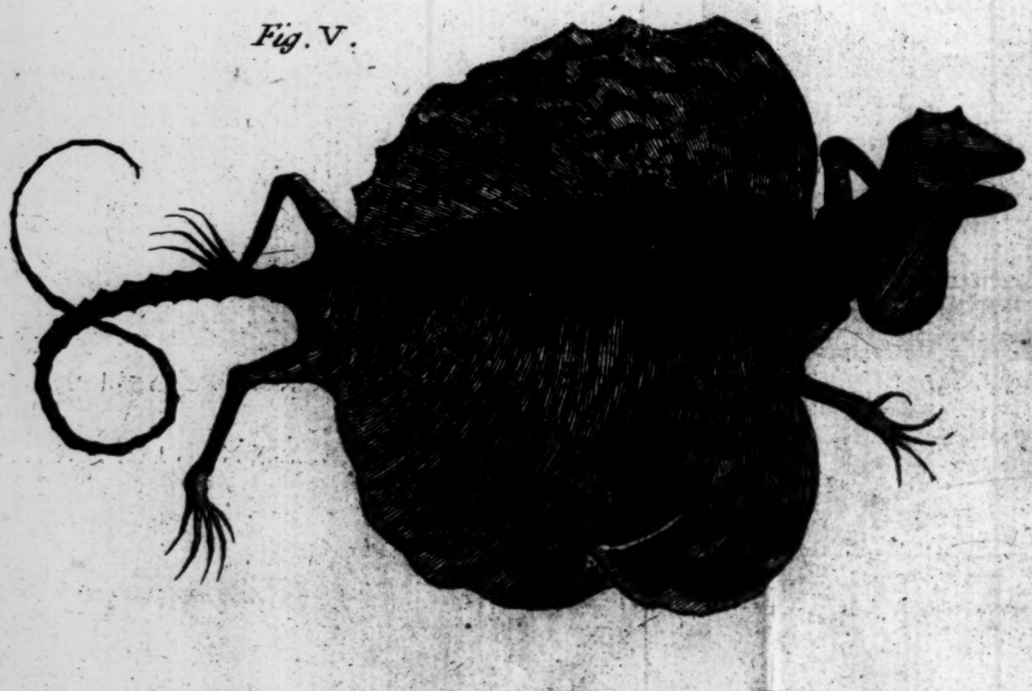


Fig. V.



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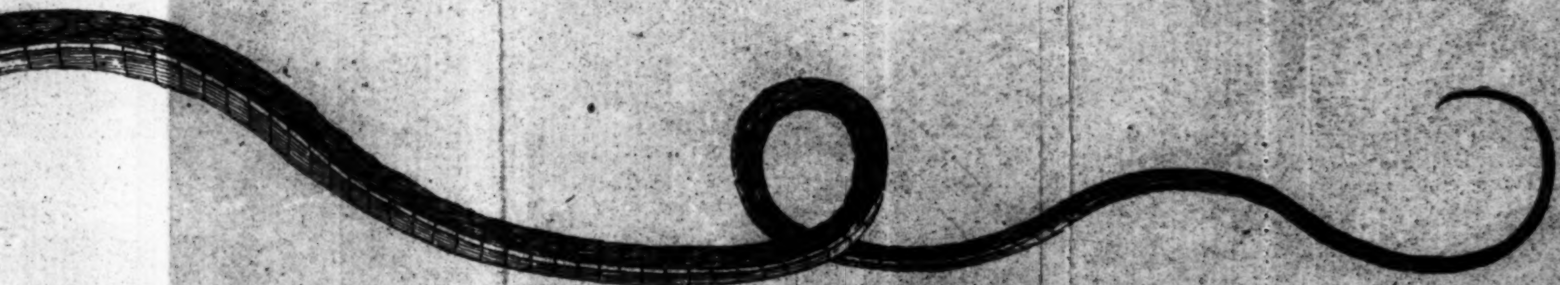


Fig. III.

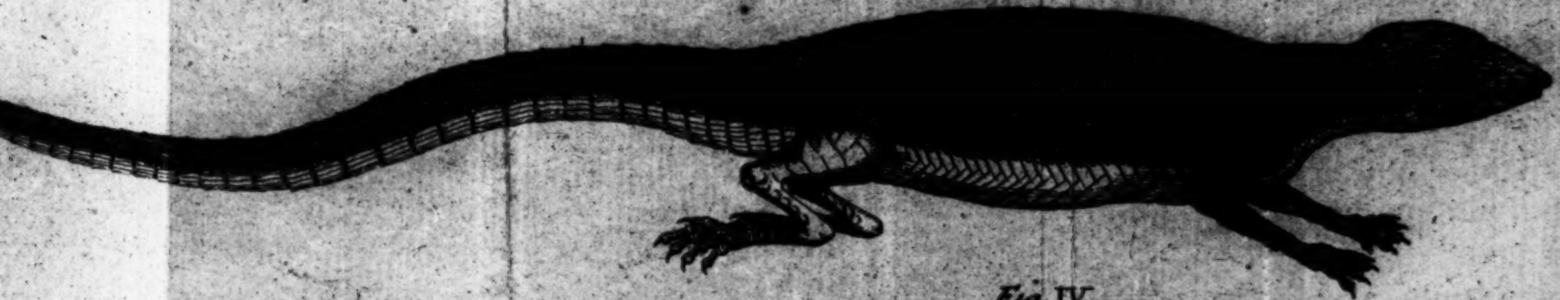


Fig. IV.

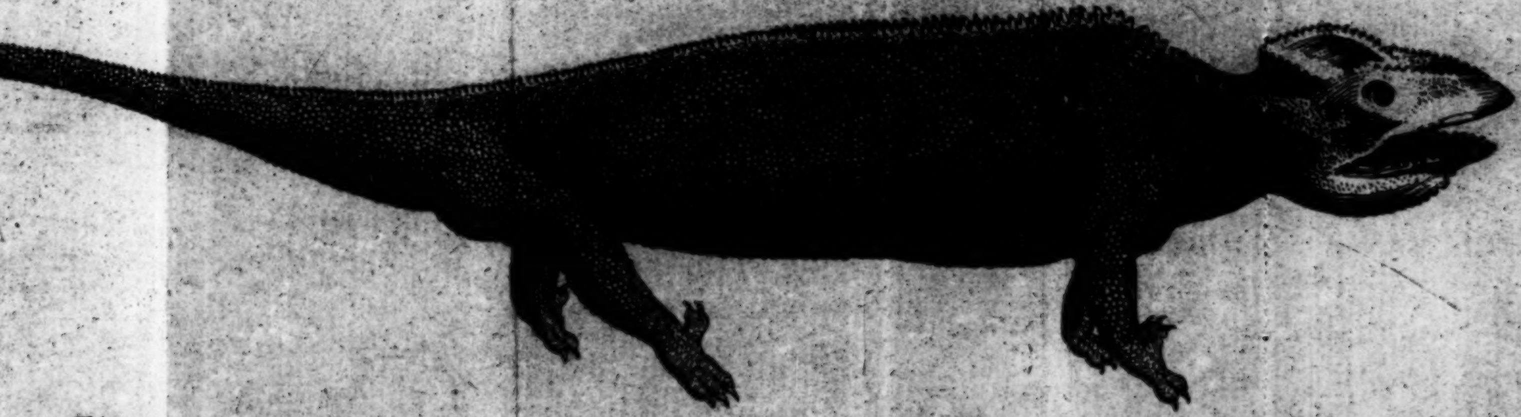
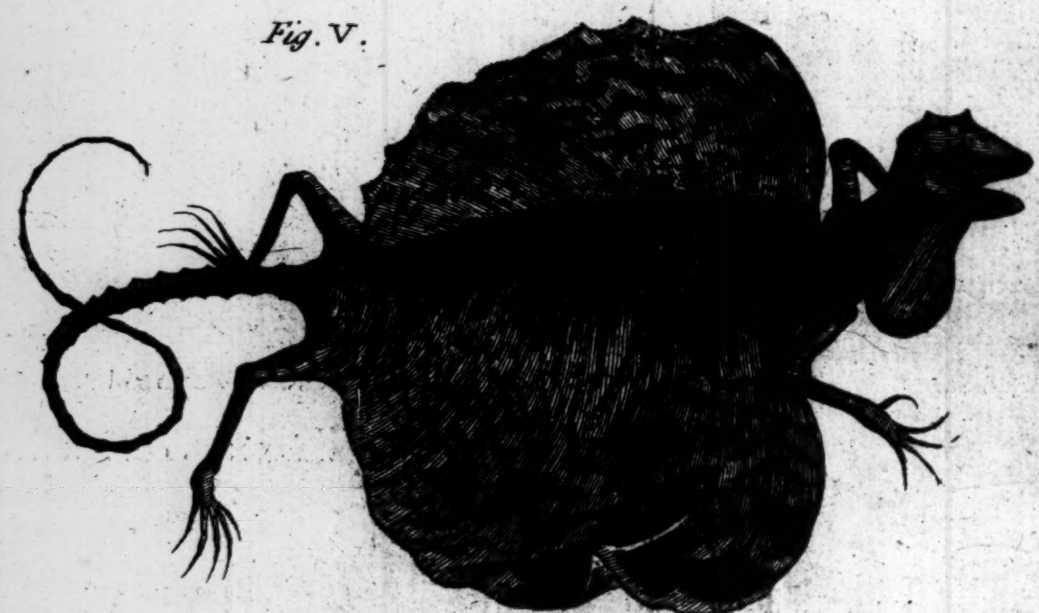


Fig. I.

Fig. V.



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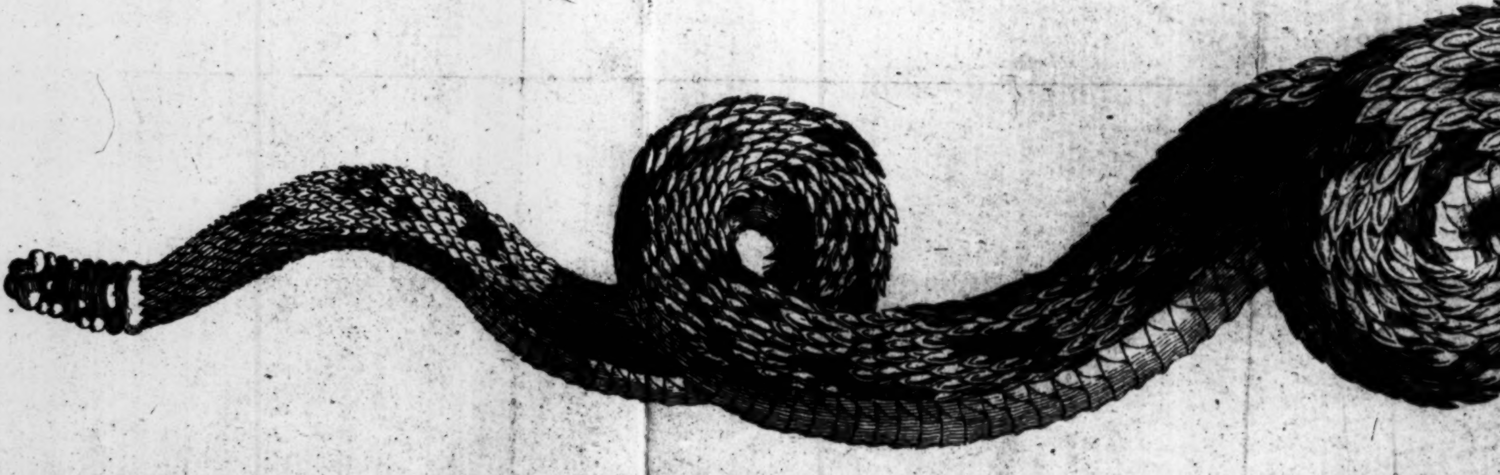


Fig. III.

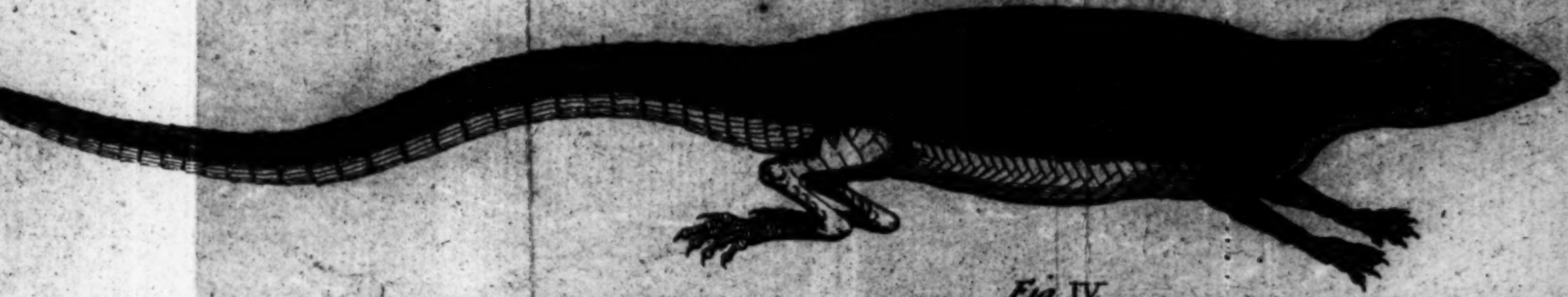


Fig. IV.

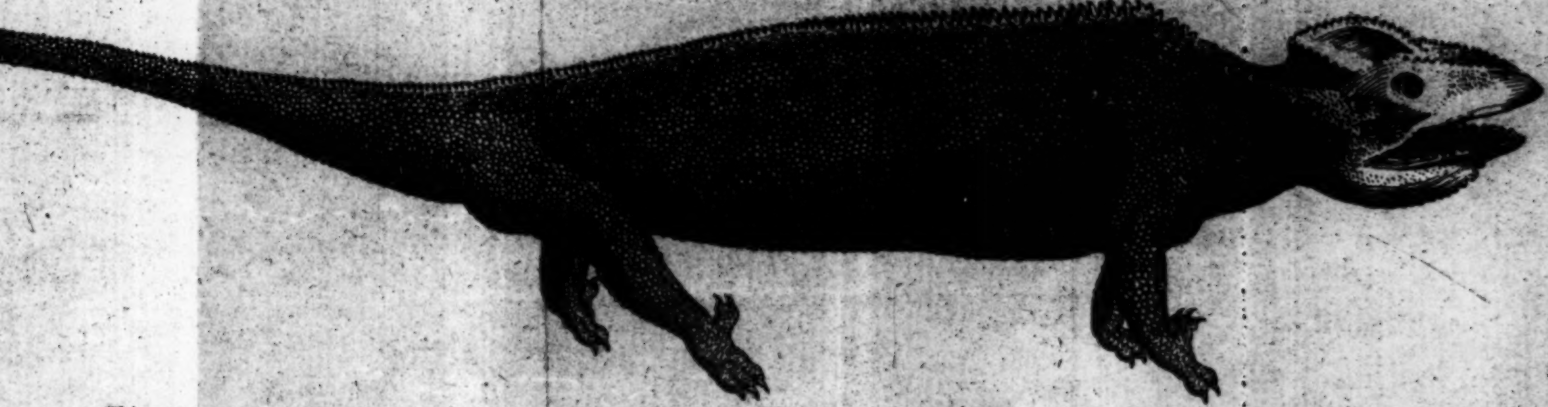
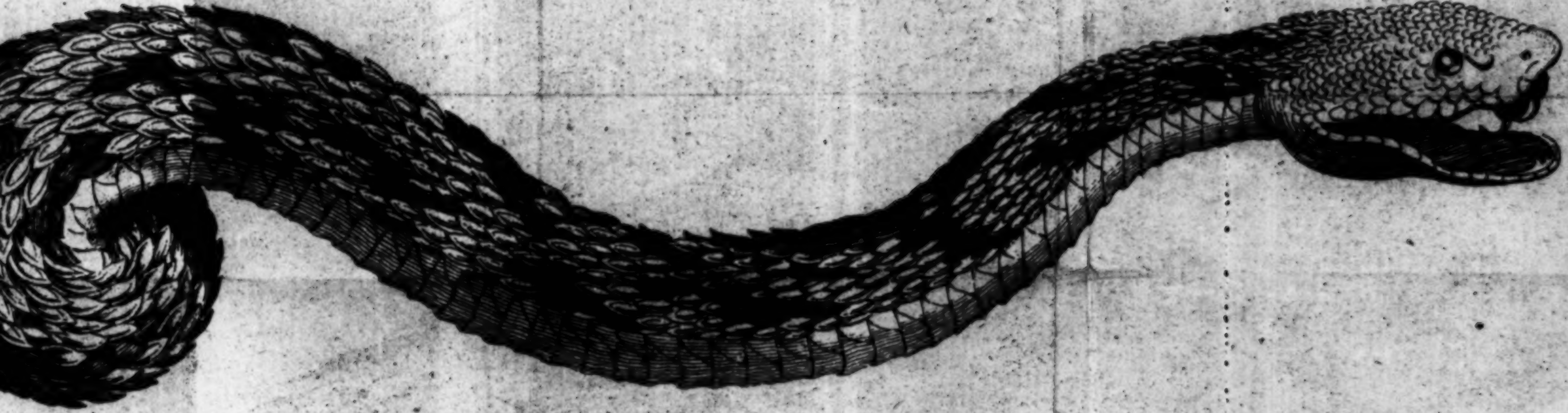


Fig. I.



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which are, like *Birds*, *Oviparous*, have 4
Branches to their Bodies, and poſſeſs the Power
of Flight. To which we may likewiſe add
hat remarkable Analogy which there is be-
ween ſome Kinds of *Birds* and the *Animals*
mentioned in the preceding Chapter, which lay
hemſelves up, or ſleep, during the Winter.

The *Birds* which have this Kind of Reſt,
nd are loſt to us, during the *Winter* Seaſon,
re *Swallows*, *Martens*, *Swifts*, *Cuckows*,
Nightingales, and ſome others; and as the
Spring Seaſon is more or leſs temperate, ſo does
t influence the waking of theſe *Birds* from the
tate of Reſt, as it does alſo all *Animals* that
leep in Winter. The *Cuckow* and *Nightingale*
ommonly begin to ſing about the firſt Week
n *April*, and the *Swallows*, *Martens*, and
wifts, appear about that Time: Nor is Na-
ure leſs bounteous to all its Off-ſpring, when it
ouſes theſe Creatures from their Lethargy.
The *Vegetables*, which the Winter Froſts re-
enched of their Beauties, are enlivened, and
iſplay their uſual Ornaments, and become an
greeable Shelter and Habitation for thoſe *Birds*
hich are re-inſtated in Life. This Tempe-
ature of Air equally puts the Juices of all the
leepers, whether *Animals* or *Vegetables*, into
Motion; and if ſuch a Temperature of Air
appens to reign for any Time before the natu-
l Seaſon, it has the ſame Effect upon their
odies, and rouſes them from their Lethargy.
t was remarkable, that in 1719, we had no

Froſt or Snow of any Continuance in *Englan* unleſs in the moſt Inland Parts. The Softneſs o the Weather in *January* and *February* was ſuc as produced the Effect I mention, of wakin theſe *Birds* before their Time. In *Lincolnſhir* and the adjacent Counties lying next the Se ſeveral *Cuckows* were ſeen and heard to ſing i the firſt 15 Days of *February*; ſome Hives o *Bees* ſwarmed about the ſame time; and *Bat* were flying about, as they do commonly i Summer Evenings; but a cold Eaſterly Win coming, ſoon afterward put them to Reſt agai These *Birds*, which ſleep in Winter, have cer tain Periods of Time in the Summer, whe they are loſt to us. About the Middle of *Jun* *Nightingales* and *Cuckows* have finiſhed the Song, and are ſeen no more till the followi Spring. Indeed, as a Matter of Curioſity, have known *Nightingales* kept in Cages for 2 o Years together; and if they have been ſet warm Places they have ſung at *Chriſtmas*. The is now a *Bird-Fancier*, in *Fetter-Lane*, in *Fle* *Street* who is never without them.

Birds differ from *four-footed* Beaſts in th Manner of their Generation, and bringing for of their Young: In theſe the *Female* has only o Cluſter of *Eggs*; but we always find 2 *Ovari* in every *Female* of the *four-footed* Race. I *Birds* and *Fowls* the *Egg* is made fecund by th *Male*, before it is excluded from the Body o the *Female*; and every *Egg* in the Body of th *Female* has a Power of Growth, to a certa Magnitude, before it can be diſcharged fro

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he *Hen*, even tho' ſhe has not been in Company with a *Cock*: For I have often ſeen *Birds* that ave been kept in Cages lay *Eggs* in *April*, altho' hey have not ſo much as ſeen a *Male* of their wn kind; but theſe *Eggs* were not prolifick, ltho' the *Hen* has ſet upon them above a Month. Among the Feather'd-Race, there s the ſame Poſſibility of Coupling between *two* f different Species, as there is between *four-ooted* Beaſts of different Kinds. It is common or *Cock Pheaſants* to tread the *Hens* of common oultry; but whether their *Eggs* are prolifick, nd if they were, whether the *Chickens* were of different Make, I know not.

The Covering or Clothing of *Birds* and *owls* muſt next be conſidered. They have rowing upon them *Hair*, *Down*, *Feathers*, and *uills*: The *Hair* is hardly to be diſtinguiſhed ut upon the larger Sort; and I think *Down* is nly found upon what I call *Fowls*; for *Birds* nd *Fowls* are in many things different from one nother, *viz.* *Birds* always carry their Meat their Young; *Fowls* lead their young ones to eir Meat. All *Fowls* make their Neſts upon e Ground; whereas on the other hand *Birds* uild for the moſt part in *Trees*, *Hedges*, &c.

Every *Fowl*, whether of the Land or Water, s its Body cover'd with *Down*, either during certain Space after it's hatch'd, or during its hole Life. The *Land Fowls*, ſuch as *common oultry*, *Partridges*, *Turkies*, *Pheaſants*, and ſuch ke, only have this *Down* upon them till their

Feathers appear. The *Water Fowls*, ſuch *Swans*, *Geeſe*, *Ducks*, *Widgeons*, *Teal*, &c. ha always a Coat of *Down* under or benea their *Feathers*.

The *Feathers* of *Birds* ought alſo to be care fully conſidered, how they vary in Make and Co lour, with reſpect to the different Parts of Bod which they grow upon; and this Variety ſeem to proceed from the Difference of the Juices the ſeveral Parts they cover. All young *Bir* are clothed in *Feathers* of very different Co lours from thoſe they are dreſſed with when f grown; ſo that I ſuppoſe, in the firſt Stage a *Bird's* Life, the Juices have not the ſa Powers in any part of the Body, that they po ſeſs in the ſecond or laſt Stage. And it is like that the *Hair* and *Wool* of *Quadrupedes* chang Colour as they grow older; for the ſame Reaſo *Feathers* I ſuppoſe to have a kind of *Veget* Life; and I think it is not unlikely that th come from *Seeds*: They are all of them *Annu* being renewed yearly; and therefore it is wonder if Want of Nouriſhment, or over-abu dant Heat of the *Bird*'s Body, alter their Colou which is no more than we meet with in co mon *Plants*, which often have the Colour their *Leaves* and *Flowers* changed as the Natu of the Soil directs. An Inſtance of this was ſome *Roots* of the *Double Blue Hepatica*, th were ſent to Mr. *Harriſon* of *Henly* up *Thames*, from Mr. *Keys's* Garden in *Tothill-Fie* *Weſtminſter*, whoſe Soil was ſo different fr

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he Ground they were planted in at *Henly*, that when they came to bloſſom there,they produced *Vhite Flowers*, and therefore returned back to heir firſt Station, where they retook the *Blue* Colour they had at firſt. And I have obſerved many other *Flowers* which have changed from he ſtronger Colours of *Blue*, *Red*, and *Yellow*, o a plain *White*, by altering the Soil.

Every diſtinct Species of *Birds* has to it ſelf a ertain Manner of feathering ; yet it is poſſible o produce other Birds from them which ſhall liffer in the Colour of their *Feathers.* I believe very Kind of *Bird* may have had one of its Race vith *White Feathers*, which happens from the Vant of Nouriſhment, or ſome ill Quality reſidng in the Juices that feed them, as was ſaid beore. I have heard that in King *Charles* the IId's Time there was a *White Crow* in St. *James's* *ark.* I have very often ſeen *White Sparrows* ; nd ſome time ſince I caught one of thoſe *Birds*, ommonly called a *Robin Red-Breaſt*, with ll the *Feathers* from the Throat downward of a lear *White*, and every other *Feather* about him erydifferent from the common *Feathers* of thoſe *irds.* In 1718 I was at the taking of one of he *Thruſh* or *Black Bird* Kind, with *White* *eathers:* This Change of *Feather*, from a rong Colour to White, is frequent among *heaſants* and *common Poultry* ; and where this appens, I find that the Coupling of one which of the natural Colour, with one of the *White*

Sort, is the Cauſe that in the Breed or Increaſe ſome are Mottled, others *White*, and rarely any of the natural Colour, eſpecially (as I obſerve) if the *Cock* was *White*. I think we may lay it down as a Maxim, that where-ever *Whiteneſs* is ſeen in the *Feathers* of *Fowls*, *Hair* of *Beaſts*, and *Leaves* or *Flowers* of *Plants*, it proceeds from Weakneſs, or Want of Nouriſhment, in the Bodies they grow upon.

It is worthy our Obſervation, the Contrivance of *Birds* in the Building of their *Neſts*; how every diſtinct Species hath a Method peculiar to it ſelf in preparing its Lodging, not only a to the Curioſity of its Frame, but the Choice of certain Materials of which it is compoſed: And even its Situation is not leſs regarded by them. The Form of a *Marten's Neſt* is wonderful, as well if we conſider how every Part of *Clay* or *Mud* is brought in little Particles to make the Whole; as alſo the Poſition of thoſe *Neſts* under Shelter of ſome Pent-houſe, or horizontal Covering, to keep them from the Injuries of the Weather. As to the Form of the *Neſt*, it is like a Cup pointed at the Bottom, with a ſmall Hole or Notch towards the Brim, pointing to the Eaſt, to go in at, and the Inſide is lined with *Feathers*, to make it eaſy for their Setting. The *Magpye* is likewiſe as careful to preſerve its Young from the Injuries of the Weather and *Birds* of Prey as the *Marten*; but Nature has given him a different Kind of Cunning; his *Neſt* is guarded on all Sides with *Thorns*, and lined with *Mud*, which he ſmooths beyond the Gueſs of any one that has not ſeen it.

The *Neſts* of other *Birds* are every one as emarkable as theſe we have already mentioned. t is, I think, impoſſible any one can paſs by he Works of theſe little Creatures without dmiring the Delicacy of their Compoſiion, and Beauty of their Contrivance; and articularly ſome of thoſe *Birds Neſts* which are o common in the *Weſt Indies*, which are faſtend to the Ends of tender *Twigs*, and hang upon trings of about half a Yard in Length. By his Means the *Birds* and their *Eggs* are ſafe rom deſtroying *Vermin*.

It is obſervable that the *Bills* of ſeveral Kinds f *Birds* are diſpoſed in ſuch Manner, that they an imitate an Human Voice; and their Memoy of ſuch Words or Tunes as have been often epeated to them is not a little ſurpriſing: It is equent to find ſome Kinds of *Parrots* that will lk much, ſing Songs, and expreſs every Syllale with ſuch Exactneſs, that many have have een deceived by their Voice. *Jays*, *Starlings*, *agpies*, *Bulfinches*, and the *Robin Red-Breaſt*, e often taught to pronounce Words diſtinctly: nd there is now at *Chelſea*, near the *Ferry*, a *aven* that ſpeaks ſeveral Words plainly. Among eſe *Birds* which I have mentioned for ſpeaking, e may farther obſerve the Tones of their oices. The *Raven* has a Voice very deep and arſe, as a Baſs to the reſt. *Parrots*, *Starlings*, d *Magpies*, come nearer the common Tone of Mankind, as it were a Tenor to the former The *Bulfinch* and *Robin Red-breaſt* ſpeak i a Treble Tone or Pipe. One would thin that the Mouths or Organs of Sound in four-footed Beaſts were near enough reſembling th Mouths of Men, to be made pronounce Words but hitherto we have not found any *Quadruped* that could be taught to ſpeak; and when I conſider this, I am ſurpriſed to find *Birds* (who Beaks are ſo very different from the Figure Frame of the Organs of Speech in Mankin ſhou'd be taught to utter Words ſo diſtinctly they do. As for the *Speaking Dog*, ſo much tal ed of, he utter'd ſeveral Words and Sounds; b they were not of himſelf, no more than an I ſtrument of Muſick could produce Variety Notes without the Help of an Artiſt to play up it. The Maſter of this *Dog* having ſet him in convenient Poſture to get the full Managem of his Throat and Chaps, made him gro and moved his Chaps and Throat in that m ner with his Hands, that ſome Words were pl enough pronounced to be underſtood; and conceive it is no difficult Matter to bring any *D* to ſpeak ſome Words, if we make uſe of ſame Means: But *Birds* repeat Words diſtinc without any Aſſiſtance of this kind.

The *Wings* of *Birds* anſwer to the Fore-feet Beaſts, ſo far as to make up the four Branche the Body; and in the Motion of *Birds* upon Ground, aſſiſt them to move forward with gr ter Swiftneſs, as well as ſerve them for Flig

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The *Quills* and larger *Feathers* of the *Wings* are emarkably different from thoſe on the Reſt of heir Body, and ſeem to bear the ſame Proportion with the other *Feathers*, that *Trees* do to *Plants* of an under Race. The other remarkable Parts of *Birds*, wherein they differ from *Quadrupedes*, are their *Beaks* or *Bills*, which re all of a Horny Subſtance, ſome long and ointed, as in the *Kingfiſher*, *Woodcock*, *Snipe*, &c. others ſharp and ſhort, as in *Nightingales*, *Linnets*, and other *Birds* of piercing Note. Others again have clubbed *Bills*, as the *Bulfinch*, &c. ſome hooked *Bills*, as *Hawks*, *Owls*, *Parrots*, which give them a hollow Voice; and in moſt *Water Fowl* flat *Bills* ſeem to prevail, as in the *wan*, *Gooſe*, *Duck*, &c. As the *Beaks* of them e various, ſo do their Notes or Voices all dif- r juſt in the ſame manner that *Quadrupedes* dif- r in the Tones of their Voices, by having their Mouths or Organs of Sound of various Makes.

The *Legs* of *Birds* are all of them covered ith *Scales*; and as to the Number of *Claws*, I ink they are generally the ſame, *viz.* 3 on each *oot*, with a *Heel*: The *Oſtrich* indeed has but 2; t theſe are all pointed with *Claws*, the which, well as the *Scales*, are of different Make and olour, as the *Fowls* or *Birds* they relate to are fferent in the other Particulars of their Bo- es. But we may take notice likewiſe, that ature was not unmindful of the Uſes of theſe rts, when they were firſt framed. To the *Birds* Prey ſhe has given *Talons*, for the better taking and managing of their Food: And to ſuch *Birds* as are inclinable to perch, ſhe has been no leſs benevolent and careful in the Frame of their *Claws*; ſo likewiſe the *Fowls*, both of the Waters and the Land, are not unprovided of ſuch Means, as only her own Wiſdom could contrive the Model of, for their Swimming and Walking.

The *Tail Feathers* of *Birds* are diſpoſed proportionably to each Kind, to aſſiſt in their reſpective Flights, chiefly by helping them to riſe from the Ground, and ſerve as Rudders to guide their Bodies in the Air.

The Movement of *Birds* upon the Ground is of two Kinds. *Crows*, *Larks*, *Water-wagtails*, and all the *Fowls* both of Land and Water, ſet one *Leg* before the other: *Sparrows*, *Goldfinches*, and the greateſt Part of the *Bird* Kind, jump from Place to Place. All the *Birds* that have fallen under my Obſervation drink Water; but there are ſome four-footed Beaſts that never drink, as the *Hare*, *Coney*, and ſome others. It is reported that the *Camel* will travel three Weeks without drinking.

The Food of *Birds* is of various Kinds, ſome preying upon *Birds*, others upon *Carrion*, others upon *Fiſh*; but the greateſt Part upon *Fruit*, *Grain*, and *Inſects*. The *Eagle*, and all of the *Hawk* Kind, with admirable Artifice take their Prey: And *Ravens*, as if their Smelling was the chief of their Senſes, will follow *Carrion* many Miles: And the *Stork*, *Heron*, and all the *Water Fowls*, are indued with no leſs Sagacity and Contrivance in catching of *Fiſh*, which is their proper Food. *Sparrows*, and other *Birds* of the lower Claſs, flock together in Corn-Fields and Gardens, where the *Corn*, or other *Grain* or *Fruit* is fit for their eating: Others are no leſs vigilant and watchful to deſtroy *Caterpillers*, and ſuch like *Inſects*, where hey are in any Plenty. From hence we may eaſonably conjecture, that the Cauſe of *Birds* aſſing from one Country to another, is to neet with their proper Food. For in the ſame Climate or Country it is impoſſible to find a ontinued Store of *Inſects* or *Grain*, all the Year, for them to feed upon.

The *Birds* of Paſſage are the *Woodcock*, *Quail*, *Wind-thruſh*, *Fieldfare*, *Stork*, and ſome thers; tho' the Seaſon of their paſſing is diffe-ent. The *Woodcock*, *Redwing*, and *Fieldfare*, nake theſe Parts their Refuge in the Winter, nd are rarely found here after the Froſt is ver; tho' I have been informed there have een *Neſts* of young *Woodcocks* taken about *Tun-ridge*; and I was once Eye-witneſs of a Brace of heſe *Birds* taken in their *Neſt* about the Middle f *May*: But I ſuppoſe the Old ones had been vounded, and could not change their Station. bout the Time theſe *Birds* commonly leave s, the *Quails* preſent themſelves; and about e ſame Time in *Holland*, and ſome other Pla-es in *Europe*, the *Storks* return to their *Neſts*. pon this Subject of the *Paſſing* of the *Stork*, I have lately received the following curious Letter, which agrees perfectly with what I obſerved of that *Bird* when I was in *Holland.*

S I R,

B*Eing lately in* Holland, *I enquired as much as I could of the People, concerning the* Coming *and* Departure *of thoſe* Storks, *which I there ſaw in ſuch great Numbers : The Account the People (eſpecially at* Harlem) *gave me, was this : That the* Storks *having bred, and the Young flying about with them, at the End of* September, *or thereabouts, as the Heat of the Summer more or leſs continues, theſe* Storks *gather together (in the Peoples Opinion, almoſt to a* Bird) *about a great Piece of Marſhy Ground, there called* Harlem Meer. *Being all aſſembled, they remain there ſeveral Days, chattering and ſnapping with their* Bills, *till the laſt* Birds *are come to them in this Place of their Rendezvous. After this they make no more Noiſe ; but in a little time they all riſe ſlowly together, ſoaring up in a great Flock and Body, making in the Air as they ſoar up ſeveral Rounds and Circles, till by Degrees this great Flock of* Birds, *which at its firſt Riſe almoſt darkens the Air, goes gradually higher and higher, till at laſt they appear to be in a manner but a Point, and ſo* diſappear *till the next Spring they viſit them again.* I am, *&c.*

The *Eggs* of *Birds* are as remarkably different from one another as the *Birds* themſelves,

and

nd ſeem to keep a juſt Proportion with the
Birds or *Fowls* that laid them. Their Spots
nd Variegations of ſeveral Colours are as wor-
hy our Remark, as the *Feathering* of their
Mother *Fowls*. The Number of *Eggs* laid by
ach Kind is for the moſt part conſtant: *Birds*
ſpecially ſeldom exceed 5 or 6 in Number,
nleſs it be the *Tom Tit* and *Wren*, which ſome-
imes lay about 12 a-piece; but *Fowls* common-
y exceed that Number. It is remarkable, that
we take away the *Eggs* of *Fowls*, they will
ill continue to lay to the Number of 30 or 40
Eggs; ſo that they ſeem to have a diſcretional
Power of ſtopping, when they have laid as ma-
y as they can ſet upon; or if they ſhould hap-
en to be ſpoiled by any Accident, they have
natural Freedom, whereby they can renew
nd make good their loſt Clutch of *Eggs*. *Spar-
ows*, and other Birds which are familiar about
Houſes, will ſometimes breed 3 Times in a
Year; and *Pigeons*, if they are well fed, will
reed 8 or 9 Times in a Year. The Time of
etting is about 3 Weeks for *Birds* and *common
Poultry*; but *Turkeys*, *Pheaſants*, and ſome o-
hers do not hatch under a Month. It is poſ-
ible to hatch *Eggs* of all Kinds, without the
Hen ſetting upon them. I have myſelf expe-
ienced the Hatching of *Chickens*, by an artifi-
ial Heat, agreeable to that of the *Hen*'s Body.

Thus have I remarked what is moſt obſerv-
ble in the *feathered* Tribe; and that I may
roceed gradually from theſe Creatures which

have the Power of Flight, to the Race of *Quadrupedes*, or four-footed Beaſts, I am obliged to take Notice of the *Batt* or *Flutter-mouſe*, and *Flying Squirrels*, which ſeem to be the natural Paſſage between *Birds* and *Beaſts*.

Of the *Batt* or *Flutter-mouſe* I have ſeen 3 Kinds, *viz.* the common Sort, frequent in *England*; one Sort about a 4th Part bigger than the common, with Ears twiſted like *Rams* Horns, about an Inch and ½ in Meaſure; and a 3d Kind brought to us from the *Weſt-Indies*, whoſe Body is as large as a *Rat*, and the Wings being extended, meaſure from Point to Point above 2 Feet. In theſe Creatures there is no remarkable Difference that I can remember, but the Size of their Parts.

Theſe *Animals* partake of the four-footed Kinds in the Make of the Head, which agrees perfectly with thoſe of the *Mouſe* or *Rat* Kind; the Shape of the Trunk of their Bodies likewiſe is much the ſame, and are both covered with Hair. Theſe *Animals* are alſo *Viviparous*, bringing forth their young ones exactly formed (like *Quadrupedes*)and giving them ſuck.

They partake of the *Bird* Kind in having only 2 Legs, beſide the Hooks at the Points of their Wings; they have alſo the Power of Flying, and ſleep like *Swallows* in the Winter. I have found many of theſe in old Walls, that have been quite void of Motion, and preſſed together ſo cloſe, that they hardly preſerved their natural Figure; and yet theſe, as I was

in-

Plate X

Fig. I

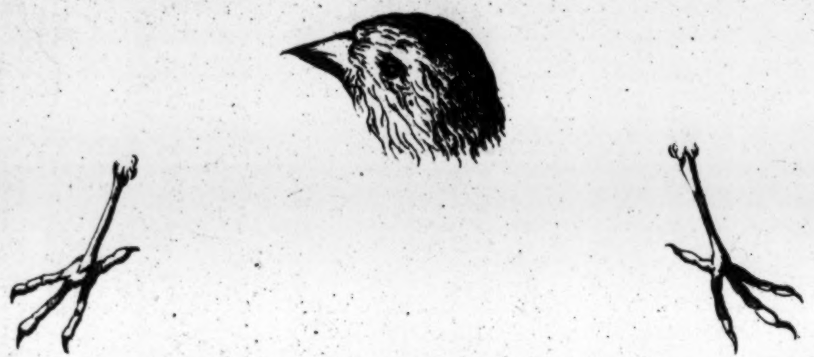


Fig. II

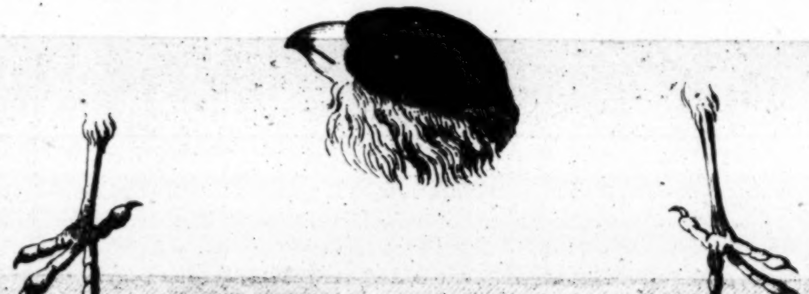
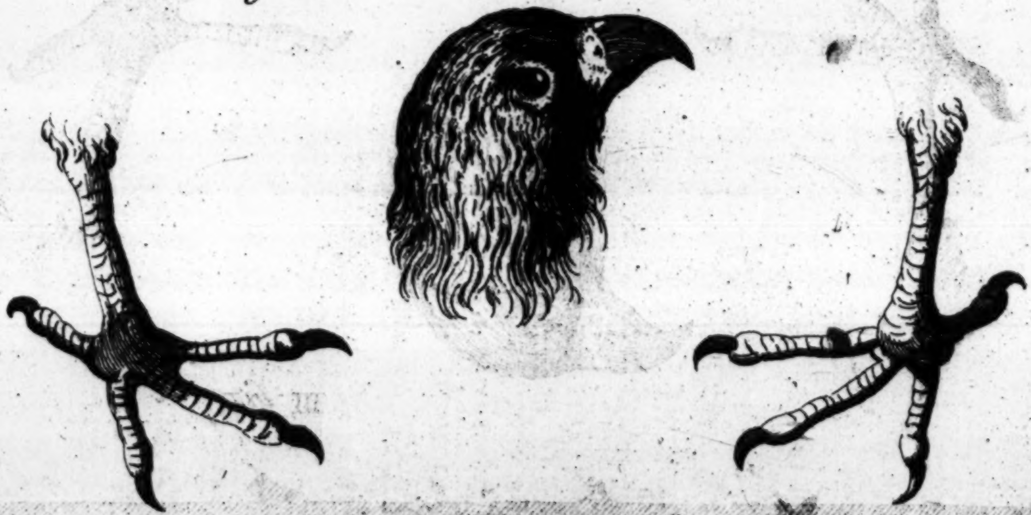


Fig. III



J. Cole Sculp

informed, having been brought to a Fire, revived, and flew about the Room. The Note or Voice of theſe *Animals* is between the Chirping of *Birds* and the Cry of four-footed *Beaſts*. Theſe Creatures have not long Tails like *Quadrupedes*.

I have not yet met with a *Flying Squirrel* perfect enough to take a good Figure from; tho' there is one in the *Muſeum* of the Royal Society, which may ſatisfy us that there is ſuch an *Animal*, and ſhew us that it has not only the neceſſary Parts for Flight, but partakes ſo much of the *Quadrupede*, as may now lead us to the Contemplation of four-footed *Beaſts*.

Explanation of the Plates relating to Chapters VII. *and* VIII.

PLATE X.

Fig. I. *The* Head *and* Legs *of a* Linnet; *the* 1*ſt ſhewing the Manner of its* Bill *or* Organs, *deſigned by Nature for the Utterance of the moſt piercing Note: The* 2*d ſhews the Manner of its* Legs *and* Claws *diſpoſed for Perching.*

Fig. II. *The* Head *and* Legs *of the* Bullfinch, *whoſe* Beak *is clubbed, diſpoſed for the Utterance of more hollow Notes.*

Fig. III. *The* Head *and* Legs *of a* Hawk, *wherein we may obſerve how Nature has diſpoſed them for the Catching of its Prey.*

PLATE XI.

Fig. I. *The* Head *and* Legs *of the* Halcyon or King's-fiſher, *which Parts are naturally diſpoſed for Climbing and Catching its Food, which chiefly conſiſts of* Inſects *in the* Bark *of* Trees, *and* Earth-worms.

Fig. II. *The* Head *and* Legs *of the* Woodcock, *whoſe* Bill *is contrived for ſearching for his Food in the Ground, ſuch as* Earth-Worms, *&c.*

Fig. III. *The* Head *and* Legs *of a* Gooſe, *which may ſerve to give us an Idea of the ſame Parts in moſt Kind of* Water-Fowl.

N. B. *Theſe Plates were drawn from* Mr. Dandridge'*s Cabinet in* Moorfields.

PLATE XII.

Fig. I. and II. *The* Bird of Paradiſe *in two Views; taken from the* Royal Society.

Fig. III. *A* Bird of Paradiſe *from* Amboyna, *drawn from Dr.* Ruyſh'*s Cabinet at* Amſterdam.

PLATE XIII.

Fig. I. *The* Back *of the common* Batt, *ſhewing wherein it relates to the* Bird-*Kind, and what Affinity it has to* Quadrupedes.

Fig. II.

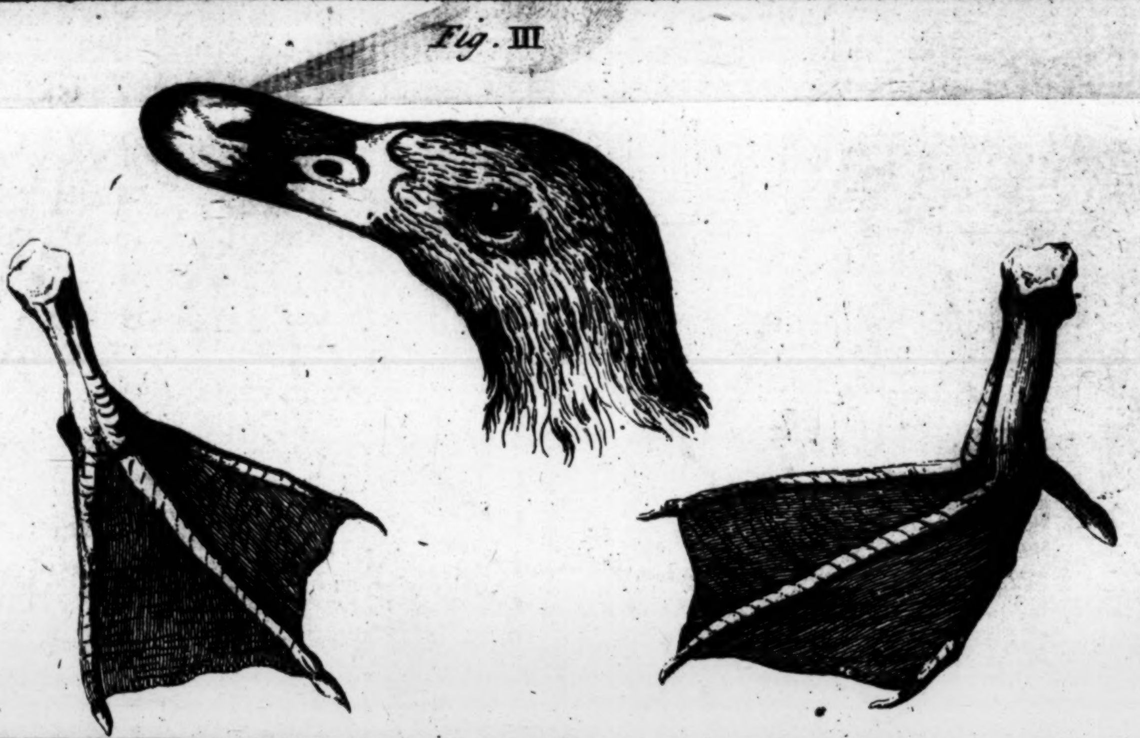


Fig. III

Plate XI.

Fig. I

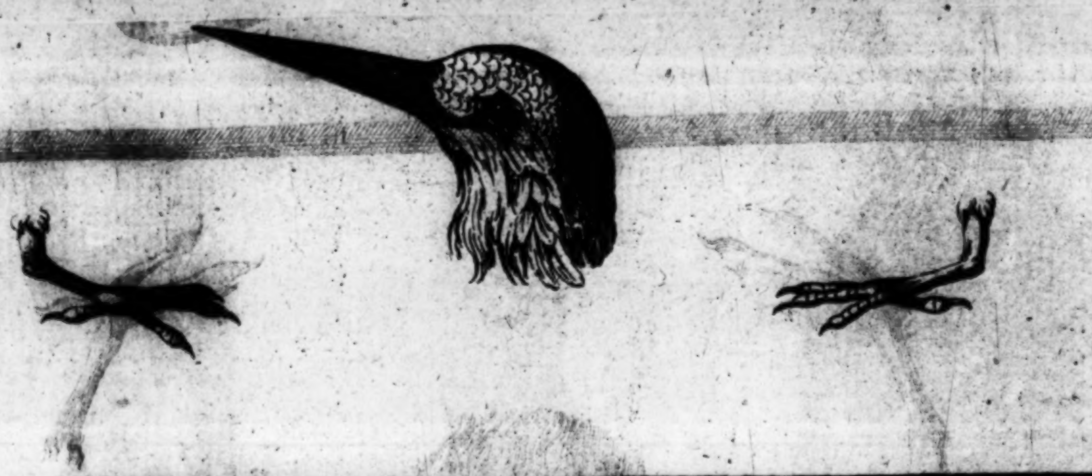
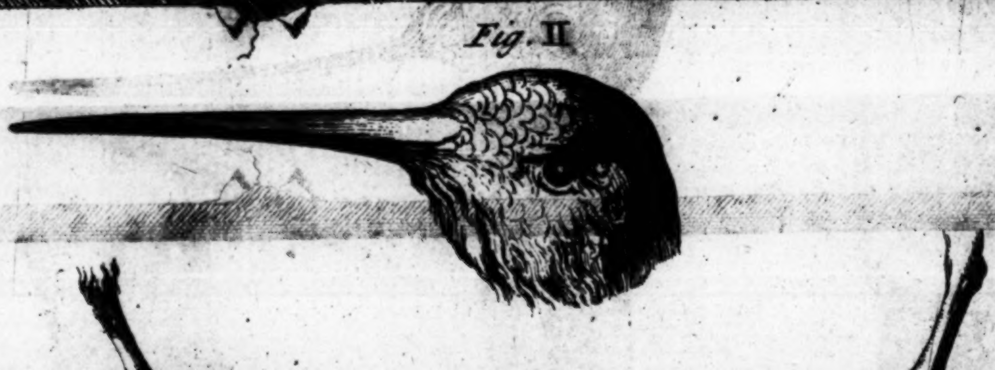


Fig. II



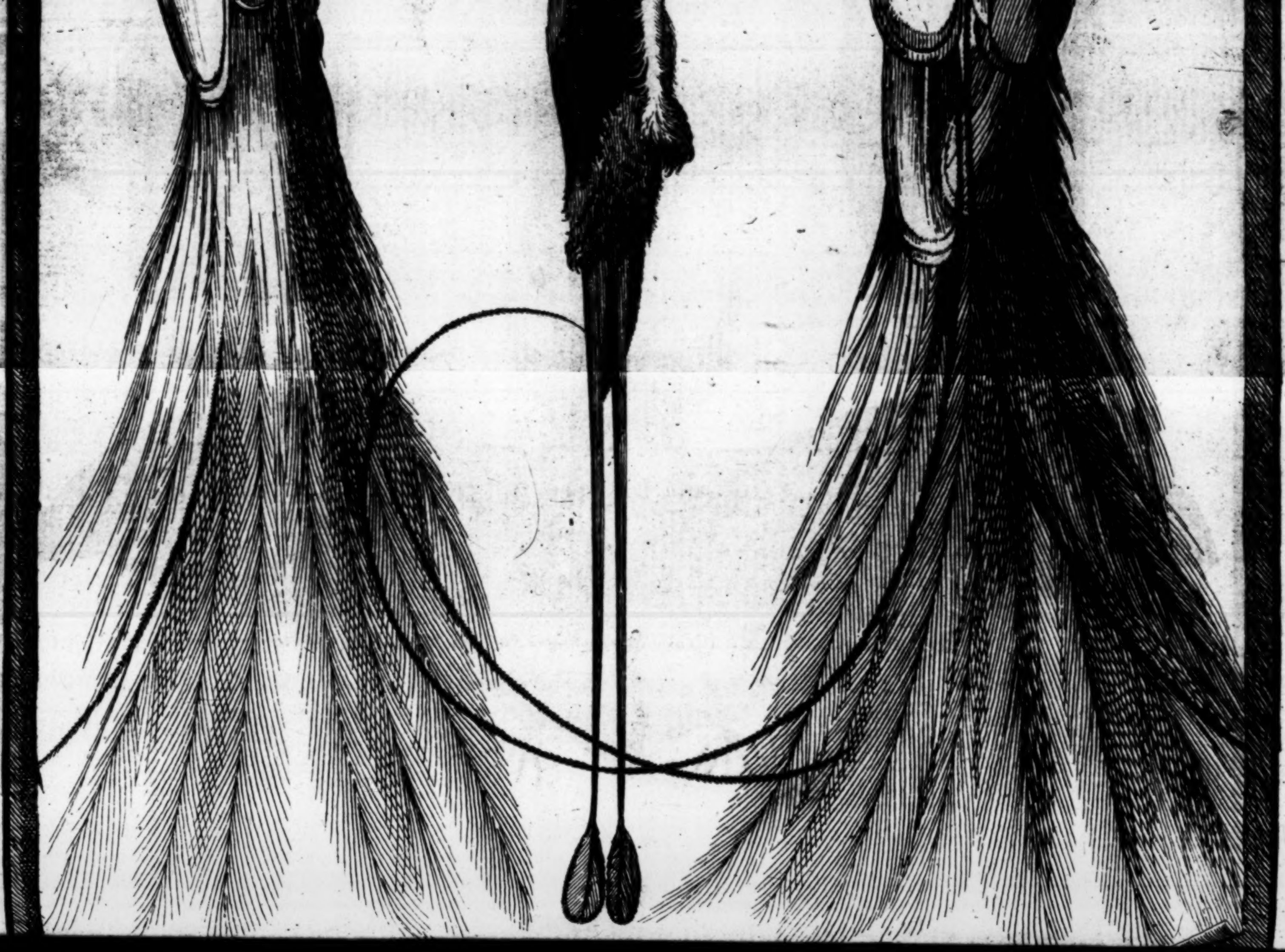


Plate XII.

Fig. I.

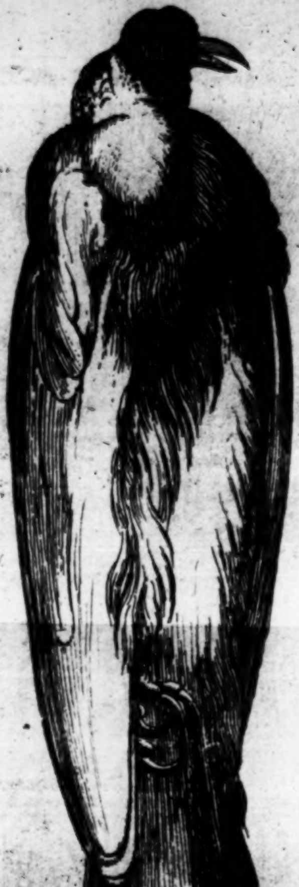


Fig. III.

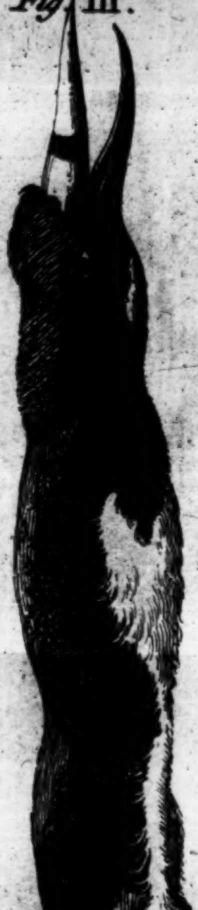


Fig. II.

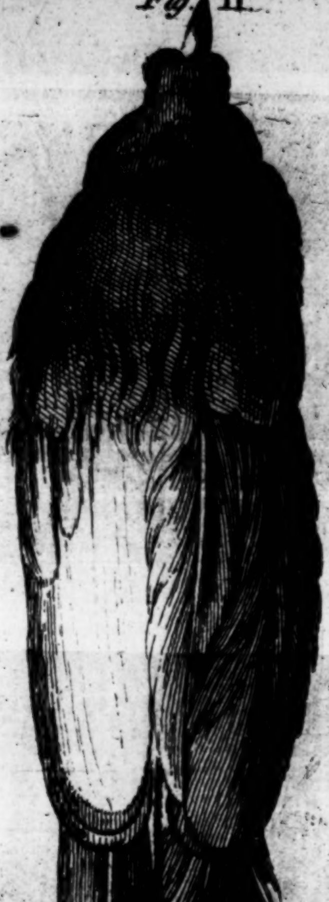


Fig. II

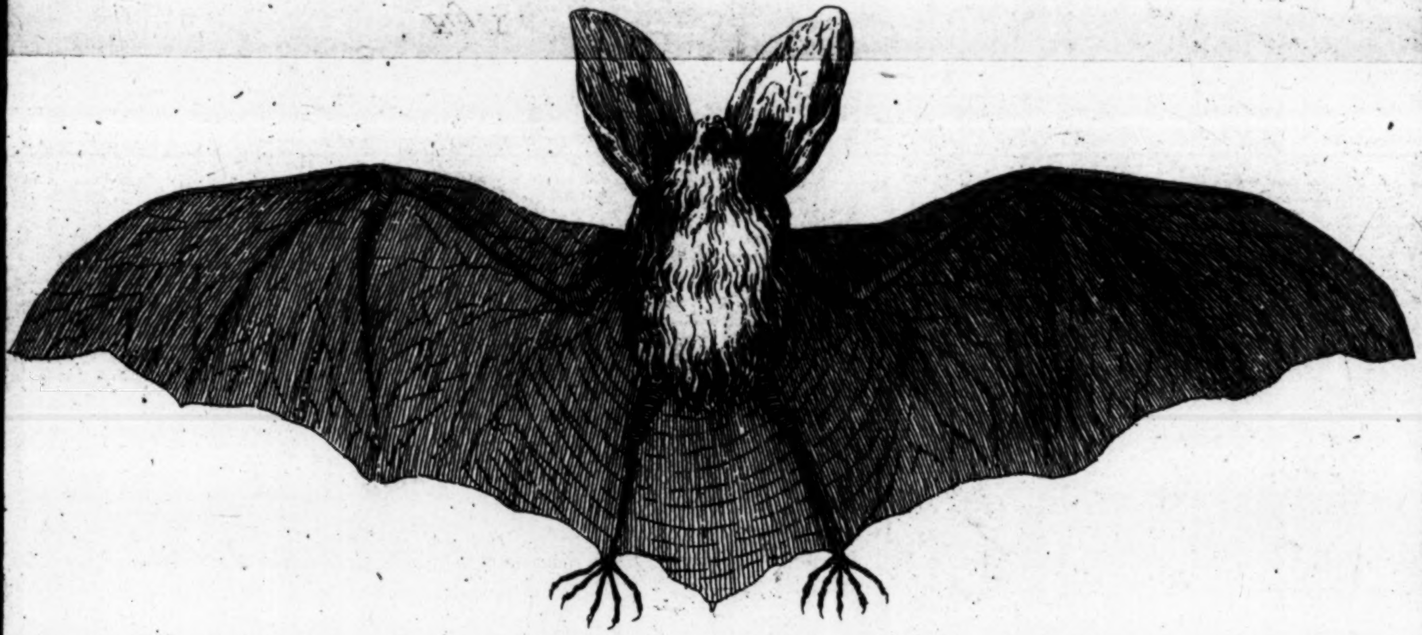


Plate XIII

Fig. II.

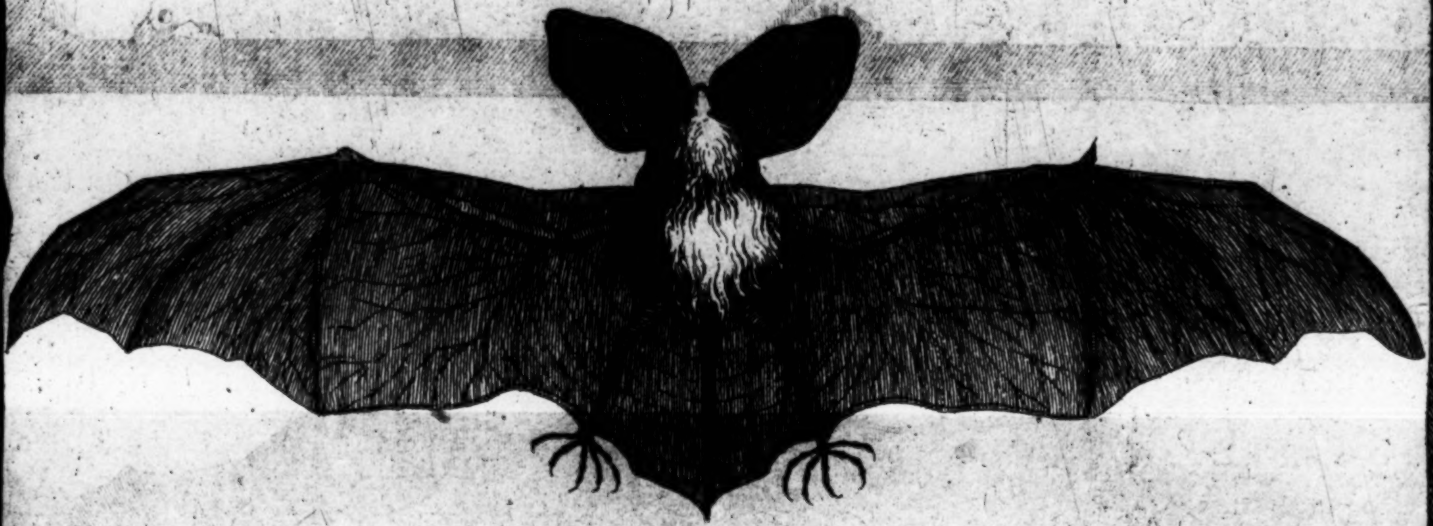


Fig. II. *The* Fore-part *of the ſame* Batt; *m Mr.* Dandridge*'s Cabinet.*

CHAP. IX.

f QUADRUPEDES, *or ſuch* ANIMALS *of the Viviparous Race, as have* FOUR *Legs or Branches to their Bodies.*

THE Tribe of *Animals* with 4 Feet are for the moſt part clothed with *Hair*; t ſome few only have a *Scaly* Covering, or e are clothed in *Spines*. The general Heads ſhall range them under are, the *Talon-footed*, e *Claw-footed*, the *Hoof-footed*, and the *double oof* or *Cloven-footed:* And again, thoſe of the *orned* Race I diſtinguiſh by the Characters of e *Perennial horned*, and the *Annual horned eaſts.*

The *largeſt* of the *foor*-footed Race is the *lephant*, and I think there is none *ſmaller* than e *Mouſe*. The Method of Motion in all this ribe is horizontal, and to a few only is given e extraordinary Power of Climbing, by leans of their ſharp *Talons*, or by the Frame r Texture of their Fore-feet, with which they n lay hold of the *Branches* of *Trees*, or whatver may be helpful to them for their Conveynce. The Walking of theſe Creatures is perrmed by moving the *Off-leg* before and *Near-g* behind at one Time, and following that lotion with the *two* contrary *Legs*; but in eir Running, they lift up at once their two

Fore-Legs, and in the next Motion follow them with their *Hind Legs*; ſo that the latter ſucceed the former in every Point of Ground, and i every Motion forwards of their Body. By thi Method of Motion a good *Horſe* will go 4 Miles in length in about 7 Minutes, which I believe is as much as any of the Race of *Quadrupedes* can do; but is not to compare with what is reported of the Flight of ſome *Birds*. If we believe the Accounts given us of the *Carrier Pigeon*, which we are told will fly 20 Miles in 15 Minutes, and may eaſily be tried; at that rate ſuch a *Bird* flies 80 Miles an Hour, which, in a natural Day, *i.e.* 24 Hours, would amount to 1920 Miles; which continued Flight, during that Length of Time, I believe is in the Capacity of a *Bird* to perform; conſidering the Paſſage of ſome *Birds*, which when they leave us, may extend to 2000 Miles, if they go into *Tartary*, or ſome Part of *Africa*; for I do not find that they are ever obſerved in *Europe* when they have left this Country. And I am of Opinion, that few *Birds* can fly much longer than 24 Hours without reſting, or at moſt 2 Days without eating: But we are ſure that Animals of the four-footed Kind cannot even maintain the Height of their Swiftneſs a quarter of an Hour: So that it appears, *Birds* have a far greater Share of continued *Velocity*, than *Quadrupedes*; which is accounted for from the Lightneſs of their Bodies.

There are 5 ſorts of *Hair* obſervable in the Cloathing of *Quadrupedes*, *viz.* the ſhort *Hair* upon the *Hides* of *Horſes*, *Aſſes*, and *Kine*; the long *Hair* in the *Manes* and *Tails* of *Horſes*; the *Wool* of *Sheep*; the *Briſtles* of *Hogs*; and the *Hairs* in the *Beards* of *Cats*, *Tygers*, &c. Theſe have every one of them a kind of *Vegetative* Growth, and are renewed yearly, unleſs the Creature they grow upon is diſtempered. I ſuppoſe them to be of the Nature of *Bulbous-rooted Plants*, which when the *Leaves* of them decay, a new-framed *Root* from the ſame *Plant* ſupplies their Loſs with freſh *Leaves* the next Seaſon. In the *Hedgehog* the *Spines* or *Thorns* which cover its Body are *analogous* to the *Hairs* upon the *Skin* of other *Quadrupedes*; but I ſuppoſe may remain for many Years, whereas the others are *Annual*; and likewiſe I imagine the *Quills* of the *Porcupine* to fill the place of *Hairs* in other *Beaſts*, tho, they are of a much harder Subſtance; and all theſe Coverings, as they proceed from the Bodies of different *Quadrupedes*, commonly vary in their Colours but are never ſo beautiful as the *Feathers* of *Birds*. Among *Beaſts* we never obſerve any *Hairs* of a *Scarlet* Colour, nor is *Blue* or *Green* natural to them, and even *Yellow* is very ſparingly given to this Tribe; while, on the other hand, *Birds* are adorned with *Feathers* of all Colours. Their Note, and Beauty of Plumage, attract the *Ear*, and cauſe in the *Eye* the greateſt Admiration; but when we conſider them farther, they are but Toys i compariſon of *Quadrupedes*, which, tho' th are not thus gaily attired, are much more ſe viceable to Mankind, and make amends for th Expence of keeping them.

The *Lyon*, *Panther*, *Tyger*, *Leopard*, an *Cats* of all Kinds, have ſharp *Talons*, ſomewh reſembling thoſe in the *Eagle* and *Hawk* Kind and for the better preſerving them from wearin or blunting their Points, Nature has provide Caſes for them in the reſpective *Paws* of tho Creatures. What they call the *Claw-foote* are *Dogs* of all Kinds, whoſe *Claws* are of Subſtance ſomewhat like the former, but ar not guarded. *Hoofs* of *Horſes*, *Aſſes*, and *Mul* are *ſingle*, and are not of ſo hard a Subſtance a the former. The *double-hoofed* or *cloven-foote* Tribe have their *Feet* caſed with Subſtances o a *Horny* Nature; of which Claſs is the *Wil* *Boar*, *Stag*, *Fallow-Deer*, *Sheep*, *Goat*, an *Kine*. In one Kind indeed of the *Hog*-Race which I have obſerved at the late Earl of *Stamford*'s, the *Hoofs* are not cloven or divided; bu it is remarkable, that if a *Sow* of that Breed i coupled with a *Boar* of the *cloven-footed* Kind ſome of the *Pigs* will be *cloven-footed*, and others *ſingle-hoofed*.

Of the *Horned* Race, the *Buck* is one of thoſe Creatures which ſheds his *Horns* every Year, and is but 3 Months renewing them again, which is a kind of *Vegetation* equal to the quickeſt growing *Plant*. The *Stag* and ſome other ſorts of *Deer* ſubject to ſhedding and renewing their *Horns* nually, like the former; and in the larger Kinds ſometimes of that Extent, that in a direct ne they meaſure from *Tip* to *Tip* above a Yard. hey are ſo ſolid and hard when they are fully rfected, and of ſo large a Size, that it cauſes dmiration, how the Animal is ſupplied with ices ſufficient to extend them to ſuch a Width ſo ſhort a Time. It is remarkable in the *eer*-Kind, that the *Females* have no *Horns*; hich I ſuppoſe is common with thoſe Creatures, hoſe *Males* ſhed their *Horns* every Year.

The next kind of *Horned Animal* is the *Gazella*, *Antelope*, whoſe *Horns* are erect, and twiſting ke a Screw; theſe are not branched, nor do I nd they ever ſhed. After theſe the *Goat* has is *Horns* twiſted, and the Points bending towards his Back, but not both of them alike. The ext is the Sheep, whoſe *Horns*, like the former, re twiſted, and regularly curled. It is obſervale, that the *Horns* of theſe laſt Kinds are always larger in the *Males* than in the *Females*; ut it is otherwiſe among Kine, whoſe *Horns* re ſmooth, and of large Extent; in theſe the *emales* have *Horns* much larger and longer than he *Males*, unleſs they have been caſtrated; in uch *Oxen* I have meaſured a Yard between he extream Points of the *Horns*.

The Food of four-footed Beaſts is either *Fleſh* r *Fowl*, *Herb*, *Grain*, or *Fiſh*. Such as feed n *Fleſh* are Beaſt of Prey, and of the moſt avage Kind, as *Lyons*, *Tygers*, &c. whoſe *Ta-*

lons are chiefly deſigned for Catching and Te ing their Prey to Pieces. The *Otter* and *Bea* feed chiefly upon *Fiſh*, which their *Amphibi* Nature and Structure of Parts enables them catch. The *Hog* Kind eat indifferently *Fleſh*, *Fiſh*, *Fowl*, *Roots*, *Fruits*, *Herbs* a *Grain*. The *Deer* Kind, *Sheep*, *Goats*, *Ki* *Horſes*, and ſuch generally as are of the *Hoof* Race, feed upon *Graſs*, *Hay*, or *Corn*. A it may be remarked, that ſuch as uſe the latt kind of Diet are the tameſt, and moſt famili with Mankind; but ſuch as feed on raw *Fle* are of great Ferocity, unleſs familiarized whe they are very young, and kept low in the Diet.

The *Qadrupedes* of Uſe and Service to Mankind are the *Elephant*, *Camel*, *Horſe*, *Kine* of a Sorts, *Sheep*, *Dogs*, *Cats*, and ſome others. Whe *Elephants* are naturally placed, they are great Uſe after they are tamed, in tra ſporting great Burdens, and carrying Me to Battle, where their Conduct and Strength of extraordinary Service, if we may believe tho Authors who have mentioned them. We hav now one of them in *London*, who is ſo obſervan of the Orders of his Keeper, that we may reaſonably place him amongſt the moſt tameable o the four-footed *Animals*; and even allow him a Share of natural Senſe, at leaſt equal, if no ſuperior, to any of his Race. He is 28 Month old, near 15 Hands high, and his *Tusks* (o rather *Horns*) are but beginning to appear, o bud in the upper Jaw, which gives me Occaſion to ſuppoſe them rather *Horns* than *Teeth*; and conſidering what vaſt Numbers of them are annually brought into *Europe*, I am almoſt perſuaded they ſhed like the *Horns* of *Deer*. It is remarkable in this Creature, that the Joints of his *hind Legs* are diſpoſed for Kneeling, as well as thoſe in the *fore Legs*, which is contrary to other *Animals*. His Method of Drinking is by drawing his *Trunk* full of Liquor, and ſquirting it down his Throat. But we may ſee a large Deſcription of one of theſe Creatures of a greater Age, and in more perfect State, with the Anatomy of him, in the *Phil. Tranſ.* N° 326, and 327, by Dr. *Blair*, F. R. S.

The *Camel* and *Dromedary* are *Beaſts* of Burden, and very ſwift; and it is reported of them, that they will live many Days without Water, even in the hotteſt Climates. Some Creatures indeed I know will live without any Water at all, as the *Hare* and *Coney*, which I have kept above 3 Years, and they have never had any.

There are many Kinds of *Horſes* remarkably diſtinguiſhed for their different Uſes. In *Northamptonſhire*, and ſome of the *Midland* Counties, are ſuch as are fit for the Coach, and drawing of other Carriages. In *Flanders*, *Denmark*, and ſome of the Northern Nations, we likewiſe find *Horſes* of Draught, differing in their Frame and Turn of Body, and varying in their Degree of Strength, as the Countries they were bred up in differ from one another.

In *Yorkſhire*, and ſome Places in *Wales*, are bred the beſt *Horſes* for the Saddle. The firſt State of their Life being among the Mountains, enables them to endure hard Labour. Beſides theſe, the *Spaniſh Horſes* are counted the moſt famous for the Parade; and the *Turkiſh* and *Barb* Kinds for Beauty, are reckoned to exceed moſt *Horſes* in the World.

Next to theſe, the *Kine* Race is accounted the moſt uſeful. In many Parts of *England*, *Oxen* are of great Service in Ploughing, drawing of Carriages, and for many other Works in Husbandry; beſides the Service of their *Fleſh*, after they are worn out by Labour, and the excellent Uſes of their *Hides* and *Tallow*, and even their *Horns* for making neceſſary Utenſils; while the *Cows* afford us *Milk*, *Cheeſe*, and *Butter*, not only ſufficient for our own Uſe, but even to ſupply the Neighbouring Countries. Nor are *Sheep* leſs uſeful to Mankind, their *Annual* Produce of *Wool* ſerving to employ as many People as their *Fleſh* can maintain in ſome Places of *England*. Their *Milk* is likewiſe made uſe of, and turns to good Account; to which we might add the Service of their *Skins*, which afford us *Leather*, *Parchment*, and *Vellum*.

Of the *Dog* Kind we have many differen Sorts, ſuch as *Grey-Hounds*; *Blood-Hounds*, *Beagles*, and others, for Hunting and taking o Game: And again, our *Spaniels*, either fo Land or Water, *Setting-Dogs*, *Pointers*, &c ſerve to find out Sport for their Maſters; an

ſom

ſome of them are even uſeful for Draught and Carriage. In *Holland* and *Flanders* eſpecially, they are commonly employed in the Harneſs, for drawing ſmall Waggons and other Carriages. To theſe we may add ſuch other Kinds of *Dogs* as are uſed for the Guard of Houſes, among which the *Engliſh Bull-Dog* is the higheſt in Eſteem, for his exceeding Fierceneſs and Courage.

The Voice of all theſe Creatures is as various as the Structure of their Mouths and Throats. We may diſcover each Kind of them by their Note or Tone, as well as diſtinguiſh one *Bird* from another by the Difference of their Song. The Parts which relate to this Kind of Speech among them, are like ſo many Inſtruments of Muſick producing different Kinds of Tones. We might likewiſe mention how aptly all Kinds of *Dogs* are diſpoſed to receive Inſtruction, and how obſervant they are to the Word of Command.

The *Apes* and *Monkeys* of ſeveral Kinds are naturally diſpoſed to imitate the Actions of Men; but indeed the Figure and Diſpoſition of their Parts agree much more with thoſe in Mankind, than the Parts of any other Creature; and I believe ſome Sorts of them might be rendred uſeful, if convenient Care was taken to inſtruct them when young. One Sort indeed, which comes from the *Eaſt Indies*, is very vicious; and I remember has more than once attempted to force a Servant of the Houſe where he was kept: But I am informed that ſome of the larger Kinds have been ſo well inſtructed, that they would perform many little Offices that their Maſter directed them to do. It is no difficult Matter to be ſatisfied how much theſe Creatures are capable of Inſtruction, ſince there are ſo many of them daily brought to *England.* They are great Lovers of ſtrong Liquors, and frequently are inebriated with them. They love *Tobacco*, and ſmoke abundantly if they can get it. Nor is the *Man-Tyger* leſs guilty of theſe Vices when he has Opportunity: His lower Parts are like thoſe of a *Monkey*, but his Head is more like that of the *Hog*, and is a Creature very ready to imitate the Actions of Men. The *Females* of theſe have Periodical Viſits, like *Females* of the Human Race. I conclude, that as the different Tone of Voices proceeds from the different Structures of the *Organs* of Sound in *Animals*, ſo the Difference of their Capacity and Underſtanding proceeds from the various Frames of thoſe Parts which furniſh the *Brain* with nouriſhing Juices.

All *Quadrupedes* generate by coupling one with another; but are differently impowered by Nature to increaſe more or leſs their ſeveral Species. Some of the larger Kind, ſuch as the *Elephant*, *Horſe*, *Kine*, and *Deer*, ſeldom bring more than 1 or 2 at a time; whereas the ſmaller Kinds of *Animals*, and ſuch as are ſubject to be deſtroyed, increaſe more plentifully. The *Hog* Kind will ſometimes bring 17 or 18 young ones at a Birth, and the *Dog* Race about 10; *Cats* and *Rabits* about 5 a-piece, *Rats* and *Mice* about 8 or 9 a-piece, *Squirrels* 3 or 4, *Hares* 2 or 3, and *Sheep* ſometimes as many. And with regard to the Generation of theſe Creatures, the natural Time of coupling is in the Spring-Seaſon, ſomewhat later than *Birds*; but by means of *forcing* Diet, ſome of them may be brought to couple even in the Depth of Winter; it is by that Means that we have *now* young *Lambs* at almoſt every Seaſon of the Year; and ſome Creatures, as well in this as in the *Bird* Kind, couple and bring forth young ones 7 or 8 times a Year, as the *Rabit* for Example, and ſome others. We may alſo remark, that every *Quadrupede* has not the ſame Length of Time appointed for its Growth to its compleat State. The large Kinds, ſuch as *Horſes* and *Kine*, are hardly full Grown in 3 Years, *Hares* and *Rabits* about 8 Months, which perhaps may depend, in great meaſure, upon the Length of Time they are reſpectively maintained in the Womb of their *Dams*; but every Kind of *Bird* grows to its full Bigneſs in a few Months; and ſome Kinds of *Fowls* are about a Year accompliſhnig their Growth; which Difference I ſuppoſe happens as the Difference of Time is appointed, more or leſs, for the Incubation and Hatching of their *Eggs*, ſome ſetting only 3 Weeks, and others a Month, before the young ones are excluded, or can make their Way thro' their *Egg-*

ſhells. And I believe the Length of Life allotted for ſeveral *Animals* is various, as the Time of their being included in the Bodies of their *Dams* is more or leſs. There are ſome of the larger Kind of Creatures which carry their young Ones many Months, as the *Mare*, *Cow*, and *Elephant*, as it is ſaid, longer than any other Creature; but *Rabits* do not go above one Month, and *Cats* two: And I believe, was it poſſible to know the Nature of all Creatures, we might find, according to their Proportion and different Habit of Body, a continual Progreſſion, with regard to their Stature, Growth and Length of Life. For in *Plants*, which I have been more converſant with, I obſerve that Kind of Progreſſion; and it is to be remarked, that the ſeveral *Seeds* which they ſpring from, have as different Degrees of Time appointed for their coming up ſprouting in the Earth; and likewiſe ſuch as lie longeſt under Ground without ſhooting, are commonly more laſting than thoſe which begin to ſhoot in a few Days; and we may obſerve ſomething of the ſame Kind in *Inſects*. The Diſtance of Time between the laying and the hatching of the *Eggs* laid by ſome ſorts, is very different from what we obſerve in others; and the Time of Life in the *Caterpillar* of one Kind, is not the ſame that we obſerve in another, no more than the Number of Days is the ſame in all, for bringing the ſeveral *Flies* out of their *Cryſaliſes.*

But it remains for me to ſay ſomething more particular of the *Generation* of four-footed *Animals*, as it is the next relating, and in ſome

Caſes is nearly agreeing with that of Mankind. Were we to conſider but the *Generation* of *Fowls*, *Fiſh*, and *Plants*, and even of ſome Creatures of the *four-foooted* Tribe which are covered with *Scales*, it will appear that the *Eggs* of the *Females* are abſolutely neceſſary for the Production of them; and I ſuppoſe that the fœcundating *Liquor* or *Duſt* of the *Male* is as neceſſary to make them prolific. In this Race of *Animals* every *Female* has its *Ovaries*, or *Egg-Neſt*, which, without the Intromiſion of the prolific Juice of the *Male*, remains ſterile or barrren; It therefore appears that the *Male Liquor* is neceſſary to impregnate the *Eggs* contained in thoſe *Ovaries*, either by ſome *Animalcules* of it paſſing into the *Eggs* there contained; or elſe that the *Animalcules* wound thoſe *Eggs*, and ſo occaſion them to grow over, and encloſe them in ſuch a manner, as the Bliſters upon *Oaken Leaves* ſwell and incloſe the little *Inſects*, whoſe *Eggs* are laid in the wounded Parts by their Originals: But this Caſe has admitted of vaſt Diſpute, either becauſe ſome of the Diſputants could not imagine how the *Animalcula* could get into the *Ovaries*; or elſe that ſome ſuppoſe theſe is not Paſſage ſufficient for the impregnated *Egg* to fall into the *Matrix*; but theſe I ſuppoſe form their Judgments on the State of thoſe *Parts* when the *Animal* is dead, which, in my Opinion, muſt then be very different from what they were when it was alive; for then *theſe* as well as all *other* Parts of the Body have a Power of contracting or dilating themſelves; and a Paſſage, which at one time is hardly capable of admitting the Point of a Pin, may probably be dilated ſo much as to give room for the Excluſion of a full-grown *Fœtus*; and certainly it would be very unreaſonable to ſuppoſe *theſe Parts* are in the ſame Poſture during Coition, that they are at another time; Nature then giving the Parts a different Action and Power of extending themſelves. I could ſay more on this Head, if the Caſe had not already been ſo greatly perplexed; and I am loth to truſt too far to my own Opinion, in an Affair of ſo much Difficulty. I ſhall therefore relate what has paſt by way of Letter concerning this Subject, between Dr. *Geoffroy*, of the Royal Academy, and Dr. *Andry* of *Paris*.

The former tells us, that ſuch as ſupport the *Syſtem* of *Eggs* in all Creatures, ſuppoſe the little *Animal* to be included in the *Egg*; but this they cannot demonſtrate till Fœcundation: Alſo they ſuppoſe the little *Germs* of *Plants* to be incloſed in the *Seeds*; but theſe Rudiments of the Plant in the *Seeds* cannot be diſcovered till after Impregnation, by the *Farina* iſſuing from the *Male* Parts. On the contrary, if we examine the *Eggs* of *Animals* before they have been rendered fœcund by the *Male*, we cannot obſerve the leaſt Principle of the *Animal*. In the *Eggs* which the *Hens* lay without a *Cock*, although they appear fair, and as large as the others, yet nevertheleſs, we can only diſcern in them an empty *Cicatricula*, in which the little Body is not reſiding. Thoſe who have had the Management of *Silk-Worms* may remark, that when

Moth has laid its *Eggs* without the Aſſiſtance f the *Male*, thoſe *Eggs* are tranſparent, and oid of that little black Point which we diſcover n ſuch *Eggs* as are fœcundated, and is the Beginning of the little *Worm* or *Caterpillar*; it is herefore we are not to expect any good from hoſe tranſparent and barren *Eggs*. It happens ſometimes that we meet with theſe tranſparent *Eggs* among thoſe that are impregnated, even ho' they were all laid by the ſame *Moth*; which muſt proceed from ſome particular Cauſe in the coupling of the *Male* with the *Female*.

We may likewiſe obſerve the ſame Thing in he *Grains* and *Seeds* of *Plants*; we often meet with *Seeds* that are without the *Germ* or *Seed-bud*, and are conſequently barren; and theſe are found even in the Middle of the faireſt Fruits. If we obſerve likewiſe the *Seeds* of any *Plant* at the firſt opening of the *Flower*, we find them clear and tranſparent; but if we examine them ſome Time after the *Flower* is decayed, that is to ſay, after their Fœcundation, thoſe *Seeds* become *Opaque*, by Means of a little Body incloſed, which is properly the *Germ* or *Seed-bud*.

The *Ovariſts* ſuppoſe that theſe *Germs* were originally in the *Seeds*, and that they are now only grown bigger than they were at firſt; but this is a bare Suppoſition; for ſince we cannot diſcover this Point by the beſt *Microſcopes*, either in *Eggs* or *Seeds*, before they have been fœcundated, and that it may be eaſily diſcovered after Coition, it is more natural to believe that thoſe

Germs were not ſubſiſting in the *Eggs* or *Seeds* before they were impregnated, but from the very Inſtant of their Fœcundation. To convince you of what I advance, conſider only what happens in the Time of Fœcundation among *Animals.*

Among thoſe *Fiſh* which do not couple, the generative *Liquor* of the *Male* is only ſcattered upon the *Eggs* which have been *laid* by the *Female*, while they flit in the Water. In other *Animals*, where Things cannot be obſerved in the ſame Manner, we know only that the *Liquor* of the *Male* is conveyed into the Cavity of the *Matrix*, even as far as the *Tubes*, where it is often found in ſuch *Animals* as have been opened a little while after Coition; and we may preſume that it even paſſes into the *Ovaries*, and ſprinkles ſome of the *Eggs* of the *Female.* It appears then, that Impregnation proceeds from an Effuſion of the *Male Liquor* upon the *Egg*; from whence we may naturally conclude, that the Effect produced by this *Liquor* upon the *Eggs*, is chiefly to convey the little *Germ* or *Animalcule*, which is found in the *Egg* after that time; and the rather, becauſe the *Animalcule* may always be obſerved in that fœcundating *Liquor*.

And we have yet more reaſon to believe that theſe *Animalcules*, which abound in the *Male Liquor*, are the Principles of Generation, or the Beginning of Man, and other *Animals*, as we find them always conſtant in the *Liquors* which are included in the *Spermatic* Veſſels of every

very *Animal*, varying according to their different Species; but we ſometimes find them wanting in thoſe *Liquors*, either through extreme Age, or when Diſtempers have rendred hem barren.

The Syſtem of the Generation of *Animals* eing thus ſtated, we ſhall reaſon only upon onſtant Facts; whereas the *Ovariſts* ſuppoſe hat the Rudiments of the *Animal* are always in he *Egg*, altho' they cannot ſee them, and moreover, that there is a fœcundating Spirit in he Generative *Liquor* of the *Male*; but theſe are uncertain Suppoſitions; for according to them, this *Seminal* Spirit muſt be exceeding *Subtile* and *Volatile:* And nevertheleſs, among the *Aquatic Animals*, this Spirit, however *Volatile* it be, ſome ſay, it is neither enervated nor diſſipated by the Waters with which this *Liquor* mixes itſelf; but this is altogether impoſſible. Some have been of Opinion, that the greateſt Part of *Fiſh* do not couple, but the *Females* caſt their *Eggs* or *Spawn*, and the *Males* which follow them ſcatter their *Milt* over the *Eggs*. Now before the Waters have extended this *Liquor* over all the *Spawn*, it muſt neceſſarily happen that the Fœcundating Spirit is diſſipated. The Difficulty of Impregnation is ſtill more conſiderable in *Oyſters* and other *Shell-Fiſh*, which are faſtened to Rocks, or the Bottom of the Sea, without having little or any Motion. The *Milt* of the *Males* is carried backwards and forwards at the Will of the Waters, and at laſt by Chance is brought to the *Eggs* of the *Females*,

males, and renders them fœcund. What wi then become of this *Seminal* Spirit, when it is toſſed about from Place to Place? If Generatio was brought about by ſuch Means, it woul ſurely have Time enough to exhale, and the the *Eggs* of *Oyſters*, and other ſuch-like *Shell Fiſh*, could not be impregnated by it.

But we ſhall avoid theſe two Suppoſitions i our Syſtem, and endeavour to produce mor ſolid Arguments for the Generation of *Animal* than the *Ovariſts* have done. And firſt, let u examine if the Generation of *Plants*, does no carry along with it ſome Analogy to that i *Animals*.

Till the *Flower* begins to fade, we canno perceive any *Body* or *Germ* of a *Plant* in th *Embryos* of the *Seeds*, or *Seminal* Veſſels; no can we diſcern any Change in thoſe *Embryos* til the *Duſt* of the *Stamina* is fallen.

This *Duſt* of the *Stamina* is neceſſary for Fœcundation; for in all *Plants* where theſe *Stamina* appear, if we cut them off before they open, the *Fruits* will not come to Maturity; o if they ſhould happen to ripen, they are without *Germs*, and are conſequently barren.

The Neceſſity of this *Duſt* of the *Stamina* for the Growth of the *Seeds*, for the bringing of them to Maturity, and for making them pregnant, is confirmed by the Obſervations of all *Botaniſts* upon the *Palm* or *Date-Tree*.

This Sort of *Plant* bears its *Stamina* upon a different *Tree* from that which bears the *Fruit*;

ſo

o that one is ſtiled *Male*, and the other *Female*. *heophraſtus*, *Proſper Alpinus*, and all the *Bo- aniſts* agree, that if a *Female Tree* has not a *ale* in its Neighbourhood, it does not bring orth *Fruit*, or if it bears any, they rarely come o Maturity; they are ill taſted, and without *ernels*, and conſequently without *Germs*. But o bring this *Fruit* to Perfection, and make it t to eat, Care is always taken either to plant a *ale Palm-Tree* in the Neighbourhood, or to ut *Branches* off the *Male Palm-Tree*, garniſhed ith *Stamina*, and tie them to the *Branches* of he *Female Palm-Tree*, and then it produces ood *Fruit*. This Obſervation was confirmed o Monſieur *Tournefort* in 1697, by *Hadgi uſtapha Aga*, a curious *Botaniſt*, Ambaſſador om *Tripoli* to the King of *France*.

There is one Objection which may be made ainſt what we have mentioned concerning the *alm-Trees*. Monſieur *Tournefort* tells us that e has ſeen a *Female Plant* of *Hops* produce *eed* in the King's Garden, where there was ot any *Male-Plant*. But we may ſuppoſe that e *Farina* or *Male Duſt* was brought to the *emale Plant* by the Wind from ſome other lace; as in the Caſe mentioned by *Jovianus ontanus*, Præceptor to *Alphonſo* King of *Na- les*, who tells us, that in his Time there were wo *Palm-Trees*, one of them *Male*, cultivated t *Brindes*, and the other *Female*, growing in e Wood of *Ottranto*; that this laſt was ſeve- al Years without bearing any *Fruit*, till at length, having out-grown and raiſed its Hea above the other *Trees* of the Foreſt, it coul perceive, ſays an eminent *Latin* Poet, th *Male Palm-Tree* at *Brindes*, altho' they wer ſeveral Leagues aſunder, for then it began t bear *Fruit* in abundance; and there is no Reaſon to doubt but it then begun to bear *Frui* becauſe it then received the *Duſt* of the *Stamina* upon its *Branches*, which was conveyed b the Wind from the *Male Palm*. We may explain by this, in a natural Manner, that *Fœcundity*, which ſo much embarraſſed the antien Phyſicians, and which they attributed to Sympathy, or Love among *Trees*. The Poetical Paſſage above-mentioned, being thus tranſlated by my Friend Dr. *Sewel*, viz.

A Female Palm *for many Years had ſtoo*
The Virgin-Glory *of* Ottranto's *Wood:*
No vernal Bloom with Flow'rs *her* Branche
dreſt;
No Cluſters *her unfruitful* Boughs *depreſt.*
Till diſtant far, in Brindes's *fair Vale,*
Aſpiring ſhe *beheld the noble* Male
Tho' diſtant, yet the genial Pow'r *ſhe feels*;
Thro' ev'ry Vein the fertile Humour trills;
The pregnant Branches *now their* Bloſſo
yield,
And ev'ry Bough *with rip'ning* Fruit *is fill*

It may be objected, that I have no ſufficien Proof, that every Grain of this *Duſt* is a *Pla*

tu

ula or *Germ*, ſince the *Microſcope* ſhews us hat each Grain is in the Form of a little *Globe* r *Egg*, either ſmooth, or ſet with Points, ometimes bored thro' the Middle, or of ſome ther Form or Manner. I agree that it is diffiult to diſtinguiſh in every one of theſe little Grains of *Duſt* the Rudiment of a *Plant*, beauſe it is wrapt up in itſelf, and perhaps may e covered with a *Membrane*, or at leaſt clothd with ſome *Reſinous* Matter; perhaps Time may diſcover ſome way of unfolding the little *Germ*, or freeing it of its Covering; but allowng this to be only a bare Suppoſition, we may agree that it is not altogether unreaſonable, ſince it is not after the Intromiſion of theſe little Bodies into the *Piſtillum* or *Uterus* of the *Flower*, hat we can perceive any *Opacity* in the *Seminal* *Veſſels* or *Embryos* of the *Seeds*, which in their Growth diſcovers to us that they are in effect the *Germs of Plants*.

In ſhort, what confirms this *Hypotheſis*, is its Uniformity with what we have diſcovered relating to the *Generation* of all living Bodies.

After having eſtabliſh'd the Proofs of our *Hypotheſis*, I am to anſwer the Objections which may be made againſt it.

Firſt, It may be objected that an *Inſect* cannot quit its Nature, as an *Inſect*, to take upon it that of a *perfect Animal*,

It is an antient Error to make the Diſtinction of *Perfect* and *Imperfect Animals*. Our Eyes do not diſcover the ſame Parts that are in ſome Ani mals, in *Worms, Butterflies, Flies, Bees,* and othe *Inſects*; ſo that ſome thought ſuch Parts wer wanting. We ſee them take their Birth in *Mud* *Dunghills*, *putrified Fleſh*, and *Rotten Herb* which has made ſome believe that theſe littl Bodies had no other Origin than a *fortuitou* *Aſſemblage of putrifying Parts of Matter.* They have even believed that larger *Animals*, ſuch a *Frogs*, *Wild Ducks*, &c. had the like Beginning, without reflecting that thoſe *Animal* were conſtantly the ſame in their Frame and Parts, which are always produced alike; and that it is impoſſible that Chance could produc an Arrangement of Parts always uniform and conſtant. We are obliged to the learned *Redi*, for having firſt ſet this Matter to rights, by giving us Proof that the Generation of *Inſects* comes from *Males* and *Females*, agreeable to the Syſtem of *Eggs*, as it is among all other *Animals*. Many learned Phyſicians, and particularly *Swammerdam*, have begun the *Anatomy* of *Inſects*; and we are obliged to that great Man for having ſhewn us that thoſe little *Animals* had Parts agreeable to ours, or at leaſt did the ſame Functions; but as that Work was left unfiniſhed, *Du Verney* has taken it up, and continues it with great Accuracy and Judgment, tracing thoſe little Creatures from the Beginning to the End; and far from repreſenting *Inſects* as *Imperfect Animals*, he diſcovers ſo much Art and Contrivance in their Structure, that they ſeem to be even more *perfect* than the moſt conſiderable *Animals*. In

Caterpillars, and ſuch *Worms* as change into *Butterflies*, and in ſuch *Reptiles* as take *Wing*, it is ſurpriſing to obſerve the Changes which happen throughout the interior Structure of their little Bodies. An infinite Number of Parts, which are folded up, explain and open themſelves at the End of a certain Time; ſome become ablolutely uſeleſs, dry up, and fall off; and others are alter'd beyond our Knowledge. Nothing can be more admirable than the Tracing of all theſe Changes. A *Frog* is a *Fiſh* in its Beginning, named *Tadpole*; it has a great Head, the Mouth of a *Fiſh*, the Fins and Tail like *Fiſhes*; it reſpires by the *Gills*, which are *Lungs* peculiar to *Fiſhes*: Some time afterward its Tail and Fins drop off, and its *Feet* appear, which are as well adapted to Walking as Swimming; the Fore-Part of its *Head*, or rather its *Mask*, falls off, with its *Gills*; in the mean while, the *Lungs*, which reſemble thoſe in Terreſtrial *Animals*, unfold and dilate themſelves, and become expanded and very viſible, from almoſt inviſible Parts that they were before. May not we look upon this as an extraordinary Perfection, and even more than Man himſelf can boaſt of, that Gift of Power in taſting Life ſucceſſively in different States and in different Elements?

TheſeConſiderations may undeceive thoſe who are prejudiced in their Opinions, that a Creature in the Rank of *Inſects* cannot become a *perfect Animal*, eſpecially if they reflect, that for the moſt part the State of *Worms* or *Caterpil-*

lars is only a State of Paſſage to bring them to another Form; ſo that thoſe *Worms* which are commonly ingendered in *putrified Fleſh*, change into *Flies*; likewiſe ſeveral great *Worms*, which remain ſome time under Ground, change into *Beetles*; *Silk-Worms*, and *Caterpillars*, become *Moths* and *Butterflies*; and I think the *Earth-Worm* is the only Species which does not ſuffer a *Metamorphoſis.*

This being premiſed, we may regard the Form of the *Worm* or *Animalcule* in the Generative *Liquor* of *Animals*, as an Inſtance of the Certainty of future *Metamorphoſis.*

It may be objected in the *ſecond* Place, that I attribute an imaginary Inſtinct to the little *Animal* or *Animalcule*, to make it riſe into its Cell. I confeſs the Difficulty of explaining ſo great a Myſtery as that of *Generation*, without meeting a thouſand Obſtructions and Queſtions, which cannot be reſolved without great Pains and Trouble; but when an Effect is ſo evident that it meets with no formal Oppoſition, it does not ſeem reaſonable to conteſt it: Such is the Difficulty in Diſpute. Inſtinct in this Place is not the Queſtion; for I have not attributed it to the little *Animal* as a Means whereby it is conveyed into its Cell. I know too well, that in Phyſical Diſputes we muſt make uſe of Mechanic Laws, and I ſhall endeavour to give ſuch as are moſt probable.

The prodigious Multitude of *Animalcules* ſwimming in this Liquor, which diſpoſes it ſelf to overflow the *Egg* that is prepared to be impregnated, makes it almoſt impoſſible, that one of them at leaſt ſhould not reach the little Opening of the *Cicatricula* ; and that from this prodigious Multitude there is not above *one* which can find place ; for the *Cicatricula* is not capable of containing any more ; but if by chance it is big enough to admit of *two*, we ſhall find two *Fœtus*'s ; under the ſame Covering, or elſe a monſtrous *double Fœtus* joined together by ſome Part of the Body. This is one Proof of the Authority of this Syſtem.

Thirdly, It may be ſaid that we carry our Thoughts too far, in ſuppoſing theſe little *Animalcules* to be the Principles or firſt Points from whence Mankind is derived, and that they may have been appointed to ſwim in the *Seminal Liquor* for other Uſes ; as for Example : They may be ſuppoſed to agitate that *Liquor*, and to falicitate the *Exhalation* of the *Spirits*.

Beſides what I have already obſerved of thoſe who ſuppoſe a powerful *Spirit* in this *Liquor*, it ſeems much more natural to me to draw this Conſequence (*i. e.*) That the *Animalcules* which are found in ſuch vaſt Numbers floating in a *Liquor* ſo neceſſary for *Generation*, are themſelves the immediate Cauſe of *Generation*, and not to believe that they are only remote Inſtruments of it ; becauſe we do not diſcover any nearer Cauſe. After this the Uſe which is aſſigned them is far from neceſſary, and there is no Likelihood that there is any Probability in it ; for every Thing that is *Li-*

quid has in itſelf a motive Power, without having Occaſion of ſuch feeble Aſſiſtance, as that which it might receive from *Animals* moving in it; for is it reaſonable to ſuppoſe that *Fiſh* were created in the Seas, or *Birds* were made to move in the Air, to prevent the Stagnation of thoſe *Liquids?* The one is not more plauſible than the *other*.

Fourthly, It is ſaid that *Conception*, by Means of the *Animalcule*, is diſagreeable to the Syſtem of the Unfolding of the Veſſels and Parts. But wherein is this Syſtem of Unfolding more attacked in this *Hypotheſis*, than in the common Sentiment of the *Eggs?* If we admit that *Adam* had in himſelf all the *Animalcules*, as it were, incaſed one within the other; do not alſo the *Ovariſts* ſuppoſe in the ſame Manner, that all their *Eggs* were incloſed one in another, and contained in the Body of *Eve?* They cannot therefore make any Objections upon that Account, ſince we may as eaſily oppoſe their Opinion of the *Eggs*. But to defend both theſe Opinions againſt thoſe who are too much embarraſſed by the Syſtem of Unfolding of Parts, let them join with me, and conſider how Nature acts in her Courſe, and they will ſee how the Syſtem of the Unfolding of Parts is incumbred; but at the ſame Time muſt agree to the Truth of it. But let us now examine what *Monſieur Dodart* ſays upon the *Fœcundity* or *Increaſe of Plants*, in his Memoirs, inſerted in thoſe of the *Royal Academy* of *Sciences*, for the

Year 1700. "It is wonderful, (*ſays he*) that "the *Fæcundity* or *Increaſe of Plants* has been "ſo little obſerved by the World, eſpecially "ſince they are ſo commonly expoſed to the "Eyes of all People; not only the *Natural* "*Increaſe of Plants* of their own Accord, but "alſo their *Artificial Increaſe*, produced by "Cutting, or Amputation of their ſeveral "Parts." This *Artificial Increaſe* he proves to be no more than *Natural*; for, *as he juſtly obſerves*, "All the Art of a Gardener cannot "give to *Plants* what they had not in them"ſelves; his Skill only aſſiſts them to unfold "and explain thoſe Parts which they were ori"ginally poſſeſſed of. Here follows an Exam"ple of the Increaſe and Multiplication of a "*Tree* by the *Seed* only, which is the laſt Term "and Object of all the Productions of a *Tree*.

"The *Branches* of the *Elm*, are ſo many "*Branches* of *Seeds* or *Grains* extremely preſſed "one againſt the other; and having taken an "*Elm* of 6 Inches Diameter, and 20 Feet "high in *Stem*, which was about 12 Years "old, I cut off a *Branch* of 8 Feet long; and "neglecting the *Seeds* which had been ſhaken "off by the repeated Blows of the Axe, and "the Fall of the *Branch*, I yet found on it "16,450 *Seeds*.

"We may ſuppoſe that an *Elm* of 6 Inches "Diameter muſt carry more than 10 *Branches* "8 Feet long; but ſuppoſe 10 only, then "theſe 10 *Branches* may reaſonably produce,

" according to the above Account, 164,500 " *Seeds*. All the *Branches* which are leſs than " 8 Feet long, taken together, make a Sur- " face more than double the Surface of the 10 " *Branches* of 8 Feet; but ſuppoſing them on- " ly double, becauſe perhaps theſe leſſer *Bran-* " *ches* are not ſo prolific as the others, then all " the *Branches* together produce 329,000 *Seeds*.

" An *Elm* may be ſuppoſed to live 100 " Years; and it is not reaſonable to ſuppoſe " that the mean State of its Fertility ſhould " be at the Age of 12 Years; we may then " juſtly reckon, that in an indifferent bearing " Year, it will produce 329,000, or may well " enough ſuppoſe 330,000 *Seeds*, which are " little enough. Again, we muſt multiply this " 330,000 by the 100 Years Life of the *Elm*, " which makes 33,000,000 of *Seeds*, which an " *Elm* produces in its whole Life-time, taking " every Thing at the loweſt Rate, and theſe " 33,000,000 came all from one ſingle *Seed*.

" But this is only the natural Production of " the *Tree*, which hath not yet produced all " that it contains.

" If the *Tree* had been headed, it would " have ſprouted afreſh from the Trunk, and " at leaſt produced as many *Branches* as it had " before in its natural State; and theſe new " Shoots would not require more than the " Space of 6 Lines, or thereabouts, in Heighth " of the Extremity of the headed Trunk to " ſhoot from.

" At whatever Place, or whatever Heighth " the *Tree* had been headed, it would have al- " way re-germinated with equal Vigour; which " is conſtant, as appears by the Example of " *Dwarf-Trees*, which are continually kept " cut almoſt down to the Ground.

" From hence we learn, that all the Trunk " of a *Tree*, from the Earth, to the firſt Ger- " minating of the collateral *Branches*, is filled " with *Principles* or little *Embryo's* of *Bran-* " *ches*, which cannot poſſibly appear all at the " ſame Time; we conceive them to be parted " by little circular Rings of 6 Lines in Heighth, " each of which in particular is ready to pro- " duce *Branches* as ſoon as an Amputation is " made exactly above it.

" All theſe inviſible *Branches* (altho' they " are hidden) are no leſs exiſting than thoſe " which appear to us; and if they were once " manifeſt, they would produce an equal Num- " ber of *Seeds*, which conſequently they muſt " already contain in little.

" Now were we to follow the Example pro- " poſed, there is included in this *Elm*, as many " Times 33,000,000 of *Seeds* as there are " Spaces, that is to ſay, 15,840,000,000 of " *Seeds*; and that this *Tree* contains actually " in itſelf wherewithal to multiply and re- " produce ſuch a prodigious Quantity of *Plants* " as would ſurpaſs all intelligible Numbers."

What will thoſe ſay to theſe Obſervations, who are afraid of over-burdening the Syſtem of unfolding Parts? Will they not be forced to acknowledge, that their Ideas are too narrow for the infinite Foreſight of the Creator in the Propagation of *Living Beings?* But it is permitted at preſent, that our Reaſon even penetrates beyond its own Power, where the Senſes have carried us; and where they begin to abandon us, they will plainly diſcover, that whatever their Senſes have ſhewn them, is nothing in Compariſon of that which may hereafter be found out; for if we only ſuppoſe that each Grain of a *Tree* contains in itſelf a 2d *Tree*, which again incloſes the ſame Number of *Seeds*; and that we can never diſcover a Grain which contains more *Trees*, nor a *Tree* which contains more or fewer *Seeds* than the preceding *Tree*; then conſequently there is a Geometrical Progreſſion of Growth, whoſe 1ſt Term is one; the 2d 15,840,000,000; the 3d the Square of 15,840,000,000; the 4th its Cube; and ſo on, *ad infinitum*; ſo that our Reaſon and Imagination would in ſome Sort be loſt, and ſwallowed up in the immenſe Calculation.

This prodigious Chain of Numbers ſtrikes Terror in the Spirits of thoſe who are not uſed to puſh their Meditations to any great Length; but thoſe who are uſed to the Study of Phyſic and Mathematics, know very well that they cannot go far without meeting ſome Kind of Infinity, as if the Author of Nature had been careful that his principal Character ſhould reſide in every Thing.

If then we agree with the Syſtem of unfolding of Parts in *Plants*, which I think there is no Reaſon to doubt of, we may as eaſily admit the ſame in *Animals*, and it will be ſo much the more demonſtrable, as this Syſtem is the moſt ſimple of all others; for if it be acknowledged, that *God* created all Things at *one Inſtant*, we need not torment ourſelves to find out how *Organized Bodies* may form themſelves, which is no more than the unfolding and explaining of their Parts one after another; whereas, on the contrary, it will always be found as difficult to explain their *Fortuitous-Formation*, as it will be to demonſtrate that *Gold*, *Silver*, *Copper*, *Steel*, and *Enamel*, being put into a Crucible, the Parts of each Matter would diſpoſe themſelves in ſo regular a Manner, as to form a Clock or Watch.

Fifthly, It is objected, that the *Animalcule* which begins to diſcover it ſelf in the *Egg*, after *Conception*, is not a *Worm*. To this I anſwer, that if we could open the *Cicatricula* of the *Egg* immediately after *Conception*, (that is to ſay, as ſoon as the *Worm* is entred into that Part) we might diſcover that little *Animal* yet under the Form of a *Worm*; but as it begins to grow bigger almoſt as ſoon as it receives a new Nouriſhment in the *Egg*, and as new Parts begin at the ſame time to unfold themſelves in it, it is not ſtrange to find it then alter from the Form of a *Worm*; and we may obſerve the different States of its Paſſage from that Form, to that of the *Animal* which is to be produced.

With regard to the Obſervations of the *Fœtus*, whether it be formed in the *Ovaria*, or in other Parts of the *Matrix* a very little while after *Conception*, thoſe Obſervations do not deſtroy my *Hypotheſis:* All that can be ſaid is, that the little *Animalcules*, which are the Principles of Mankind, loſe the Figure of *Worms* a little after they are entred the *Eggs*, and begin to take upon them the human Form: And as to the Obſervation of our learned Critic, that Nature gives the moſt *perfect Animals* a longer Time of Ripening, or coming to their laſt State, altho' it is not a General Rule, yet nevertheleſs it happens to be true enough in Mankind.

Among the Obſervations of the *Fœtus* inſerted in the *French Tranſactions* for 1701, *M. Dodart* has given us One of the moſt remarkable, of an *Embryo* of 21 Days; it was then but 7 Lines in Length, and it was difficult to diſtinguiſh its Parts; the *Head* and the *Trunk* of the Body only could be diſcerned; the *Thighs* and *Arms* were not yet unfolded; and the *Head* was one 3d of the whole Length. Can we then ſay that this *Embryo* had the perfect Figure of Mankind, or was entirely formed? and was it not in this State more like to a *Worm*, which it was originally, than to the Form of a Man? For we may ſuppoſe that the *Head* of the little *Worm* was become the *Head* of the *Fœtus*, and that the reſt of the Body had been hidden in that Part, which made the *Tail* of the ſame *Worm:* But here I may ſay that the *Worm* is not yet perfectly of the Form of Mankind (to ſpeak like our Author) at the End of 9 Months, when he ſhould come into the World; for we may ſay that he is not in his perfect State till he is 21 Years old, which is about the Time when an human Body has acquired all its Proportions; which agrees with the Account of our Critic, who will not be ſurprized, that a *Worm* may be changed into a *perfect Man* in ſo long a Space of Time.

Sixthly, In the next Place ſome attack the *Syſtem of Plants*, and object that the Diſpoſition of certain *Piſtils*, which lengthen themſelves beyond the *Apices*, cannot therefore admit of or receive the prolific *Duſt*.

I agree that ſome *Piſtils* are much longer than the *Apices*, and have their *Orifices* a good Diſtance beyond them; but this only happens in reverſed *Flowers*, ſuch as the *Crown Imperial*, &c. where this Situation of the *Piſtillum* favours Fœcundation; for in ſuch *Flowers* the *Duſt* cannot fall from the *Capſules* of the *Apices*, without falling upon the *Piſtils*, which, in ſome Subjects, are garniſhed with little *Hairs*, the better to retain the prolific *Duſt*; beſides, moſt of them are indued with *Glutinous* ar *Viſcous* Matter. In the *Tulip*, and ſome other *Flowers*, the *Piſtillum* does not begin to raiſe itſelf above the *Apices*, till they are full ripe, and have ſcattered their *Duſt*.

I agree that it is not ſufficient to prove only that the prolific *Duſt* of the *Apices* may fall upon the *Piſtils* of the *Flowers*; we muſt conduct it even into the very *Cells* of the *Seeds*: And I own that it is very difficult to comprehend how this *Duſt* can get there; but becauſe we find a Difficulty in any thing, are we therefore to conclude it is impoſſible? and eſpecially when we may obſerve ſo much Preparation as we ſee in *Plants*, towards the perfecting of the prolific *Duſt* in the *Apices*; as alſo how it is ſcattered when it is full ripe, at a certain time, when the *Piſtils* are ready to receive it: May we not remark as much Difficulty in the *Generation* of *Animals*? When we find that the Entrance of the *Infundibulum*, or *Vagina*, of the *Matrix* in *Birds* is very diſtant from the *Ovaries*, one can hardly imagine how the *Eggs*, when they detatch themſelves from the *Ovaries*, ſeek out the Overtures of the *Vagina*, although there is no doubt but they do. So all the Garniture of *Flowers* may perſwade us of the Neceſſity of the prolific *Duſt* for impregnating the *Seeds*; and the Proofs which I have already given may convince us of it. A few Obſervations, which Time may produce, will ſet this Matter in a clearer Light.

Seventhly, I am told that the *Bloſſoms* of an *Abricot-Tree*, which were robbed of the *Apices* by *Vermin*, produced good *Fruit*. But are they aſſured that all the *Apices* were intirely eaten, or whether they were deſtroyed before they had ſcattered away ſome of their *Duſt*?

Eighthly, We are not to ſuppoſe that the

Wind can be an Intermitter in this Kind of Fœcundation.

But is it more difficult to ſuppoſe that the Air is an Intermitter in the Fœcundation of *Plants*, than to make the Element of Water an Intermitter in the Propagation of *Fiſh*, and chiefly of *Oyſters* and other *Animals*, which lie *immoveable* at the Bottom of the Sea?

Ninthly, Some add, that if the little *Grains* of the prolific *Duſt* were ſo many *Plants*, they would produce as many *Plants* as there were *Grains* falling upon the Earth. And why then don't they raiſe the ſame Difficulty in the *Liquor* deſigned for the Propagation of *Animals*? For, in ſhort, if the little *Animal* or *Animalcula* does not meet with a convenient Nouriſhment in the Earth or Water to make it grow, and can only find what is neceſſary for its Support in the *Egg* of the *Female*; neither can the little *Germ* of the *Plant* meet with a proper Nouriſhment in the Earth to unfold its Parts, but only finds it in the *Embryo* of the *Seed*.

If my Reader will examine impartially the ſeveral Opinions upon the Generation of *Plants* and *Animals*, and weigh well the Proofs of one and the other, and obſerve the Difficulties which are to be met with in all theſe *Hypotheſes*, I doubt not but he will agree with ours, as it is the moſt general, and has leſs Suppoſitions than the others; and after all, I deſire him to obſerve that I lay this down only as an *Hypotheſis*, in which appears more Probability of Truth than any I have yet ſeen upon this Subject.

There are *two* Things yet remarkable i *Generation* after the *Eggs* are impregnated. I ſome *Animals* the *Eggs* are excluded from th Body of the *Females*, to be afterwards incubated and ſet upon, till the Creature is ſo far perfected a to break its way thro' the *Shell*, as in the Caſe of *Birds* and *Fowls*, which are therefore called *Oviparous:* But the Caſe of *Quadrupedes* is different; the *Fœtus* is not excluded from their Bodies, till it has taken that Form or Figure which it maintains to the End of its Life: Such *Animals* are termed *Viviparous.* One might make yet ſeveral remarkable Diſtinctions among thoſe created Bodies which are *Oviparous.* The *Eggs* of *Birds* hatch at once into Bodies properly formed, agreeing with the Figures of their own Race. The *Spawn* or *Eggs* of *Frogs* have ſeveral different Changes before they gain their compleat Figure. The *Eggs* of *Butterflies* and *Moths* hatch at firſt into *Caterpillars*, and from this Shape change into a *Chryſalis*, and from that again into the Fly. The *Seed* or *Eggs* of *Plants* hatch at once into a *Plant*; tho', indeed, we may obſerve in ſome of them a conſiderable Difference between the *Seed-leaves*, and thoſe which they are adorned with when they ſhoot out their *Stalks* and *Branches:* The *Ear-leaves*, or thoſe next the *Root*, as I have already hinted, doing the ſame Office to the *Virgin Plant*, as the *Breaſts* or *Dugs* of the Mother *Animals* do their Young, *i. e.* to furniſh them with their firſt Nouriſhment, and ſupport them till they can find a ſuitable Food in the Earth: And this is ſo certain, that if we take away the *Ear-leaves* of a *Plant*, ſoon after it has made its firſt Shoot from the *Seed*, the *Plant* will die in a ſhort Time. The *Eggs* or *Spawn* of *Fiſh* hatch and become *Fiſh* at once; but in ſome of this Race (I am told) the *Eggs* or *Spawn* are not impregnated till after they are excluded from the Bodies of the *Females.*

It is obſerved by ſome great Men, that the *Animalcules* in the *Seminal Liquor* will live ſeveral Days after the Death of their *Male* Parent; and even ſome have gone ſo far, as to affirm, that theſe *Animalcules* will remain alive in the *Matrix* of the *Female* 2 or 3 Months after the *Liquor* has been lodged there, altho' they had not the Advantage of the proper *Nidus* or *Egg-neſt* to afford them any Help; and then conclude, that thoſe Parts may be impregnated by ſuch *Animalcules* 2 or 3 Months after Copulation, which (as they ſay) is the Reaſon that ſome *Females* are longer between the Time of Coupling with the *Male*, and bringing forth their Young, than others; ſo that, according to their Syſtem, ſome of the human Race may bring forth 11 or 12 Months after they have been with a *Male*.

To confirm the Syſtem of *Generation* by the *Animalcules* in the *Male Liquor*, we may obſerve, that in ſuch *Animals* as are not yet arrived at their higheſt Perfection, the *Male Liquor* in them is wanting of *Animalcules.* If we examine the *Teſticles* of ſmall *Chicken*, or any young *Bird* or *Fowl*, ſoon after hatching, or any *Animal* newly brought into the World, the *Male Liquor* has not any *Animalcules* in it, no more than can be found in the *Seminal Veſſels* of an extreme old Man, or any Creature that has been worn by Diſtempers; but we never fail to find them in vaſt Numbers in ſuch Bodies as are full grown, and in a vigorous State of Health. But I ſhall conclude this Account of *Generation*, with obſerving only, that the *Egg* of the *Female*, before Impregnation, ſeems to poſſeſs a Degree of Growth or Life, ſomewhat like that in *Minerals*; when the ſame *Egg* is impregnated, it then poſſeſſes a Kind of *Vegetative* Growth; and takes upon it the *Animal* Life and Growth as ſoon as it quickens, at which Time it only begins to enjoy the Power of *Senſation.*

We come now to obſerve ſuch of the four-footed Race as are *Amphibious*, or live as well upon the Land as in the Waters: Such is the *Hippopotamus*, or *River-Horſe*, which is found about the River *Nile*, which Creature is as big as a large *Bull.* There is now one of them well preſerved at the Phyſic Garden at *Leyden.* After this the *Otter* and *Beaver* may be obſerved, as *Animals* which inhabit Pools,

Ponds,

Plate. XVII.

Fig. I.

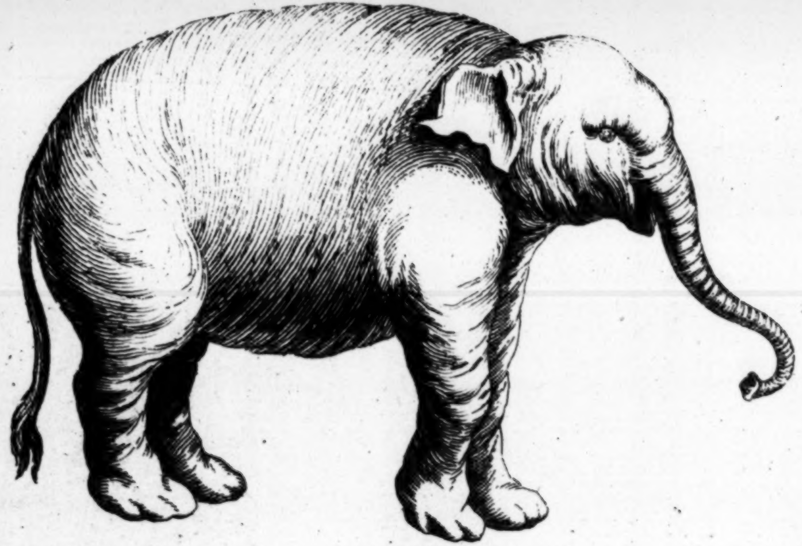
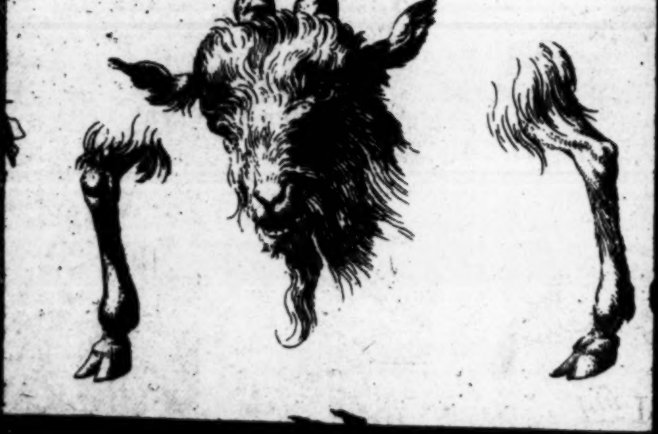


Fig. II.

Fig. III.



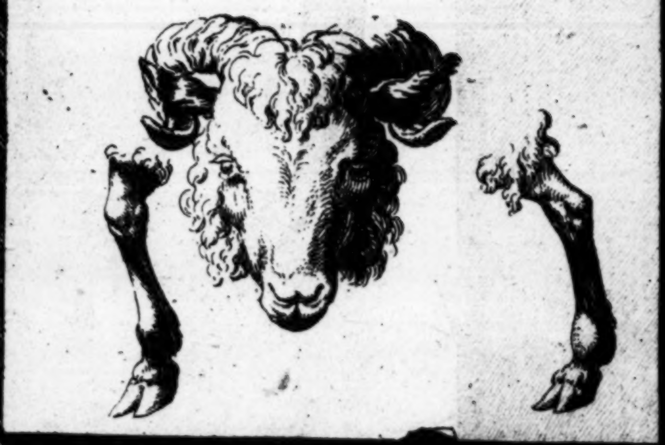


Fig. IV.

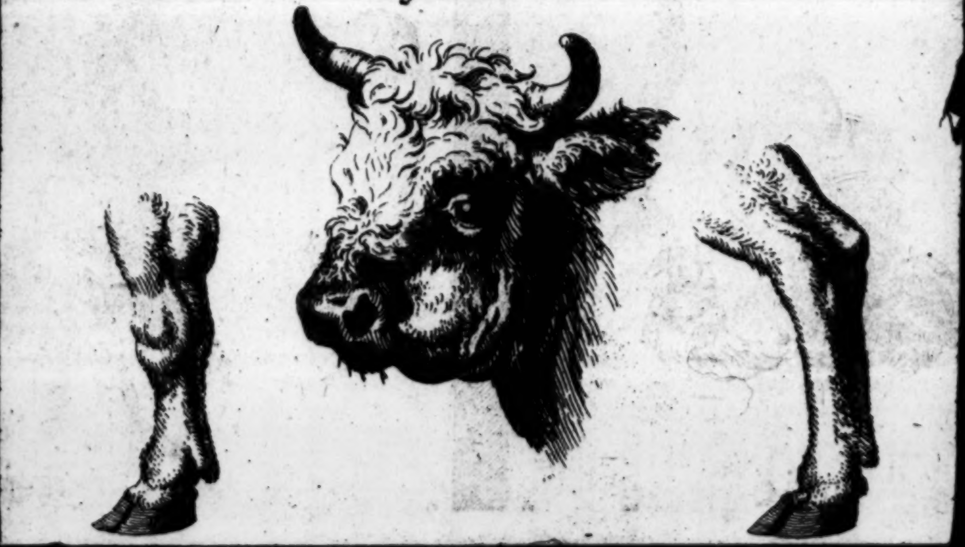


Plate.XVI.

Fig. I.

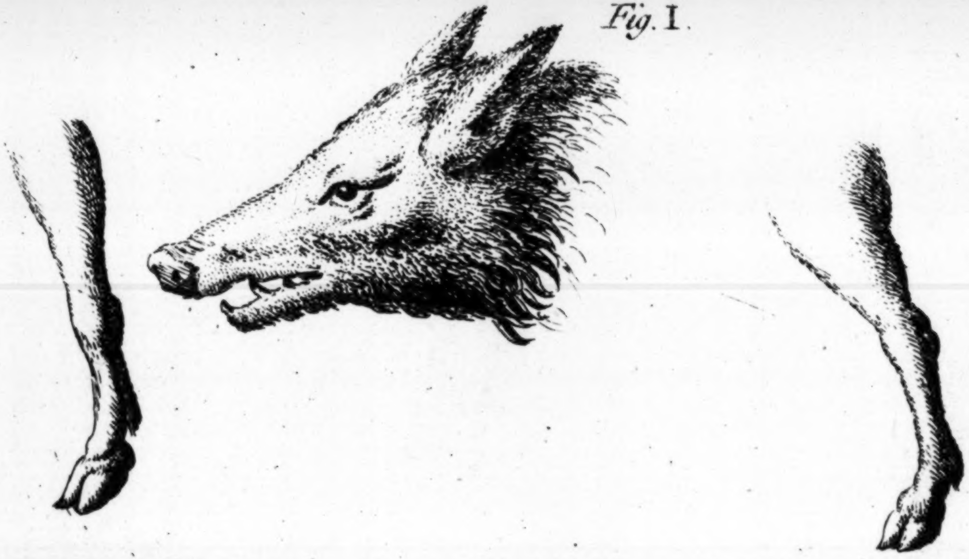


Fig. II.

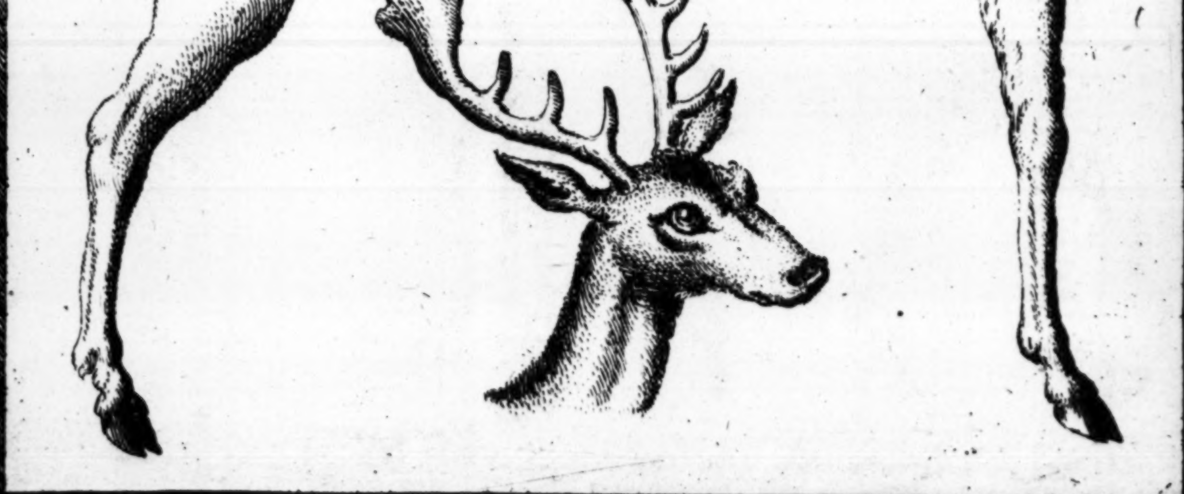


Fig.III.

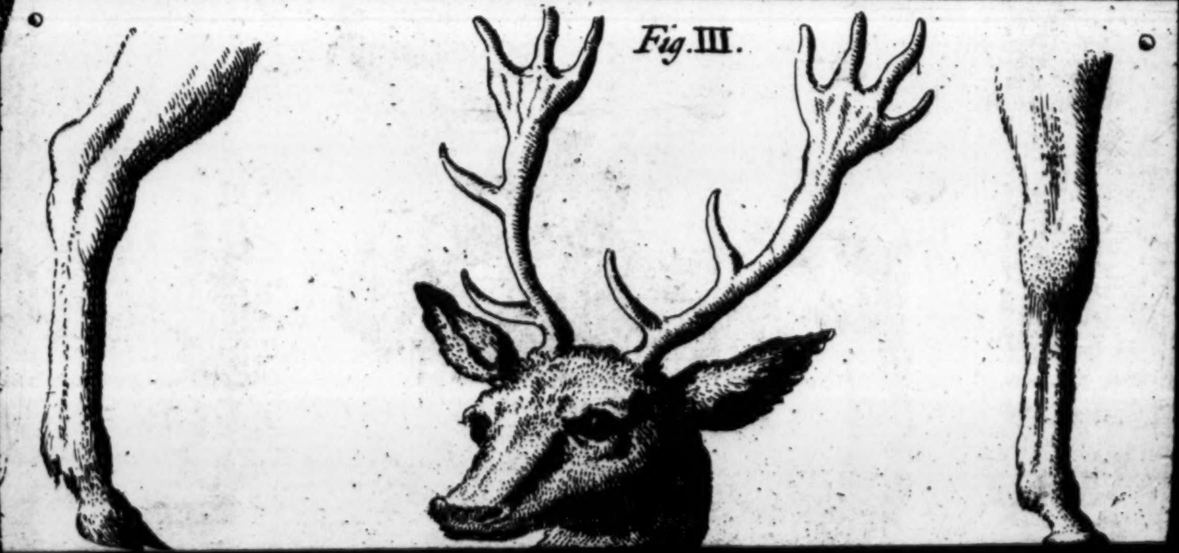


Plate XV

Fig. I

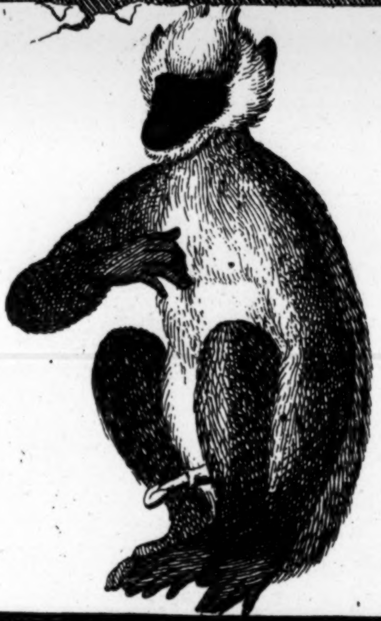


Fig. II

Fig. III

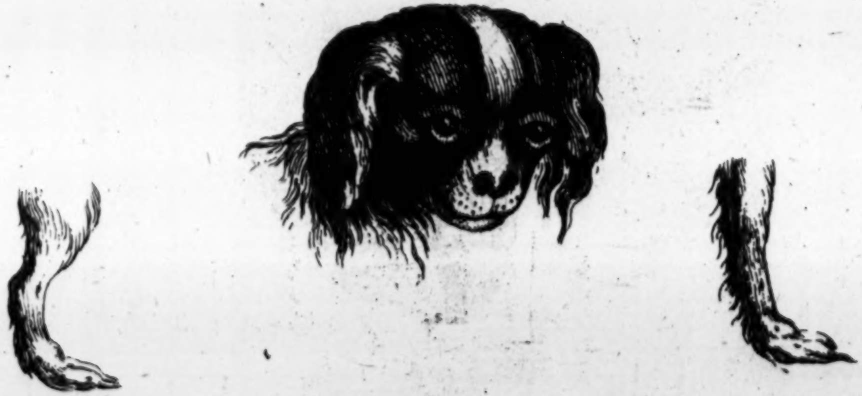


Plate XIV.

Fig. I.

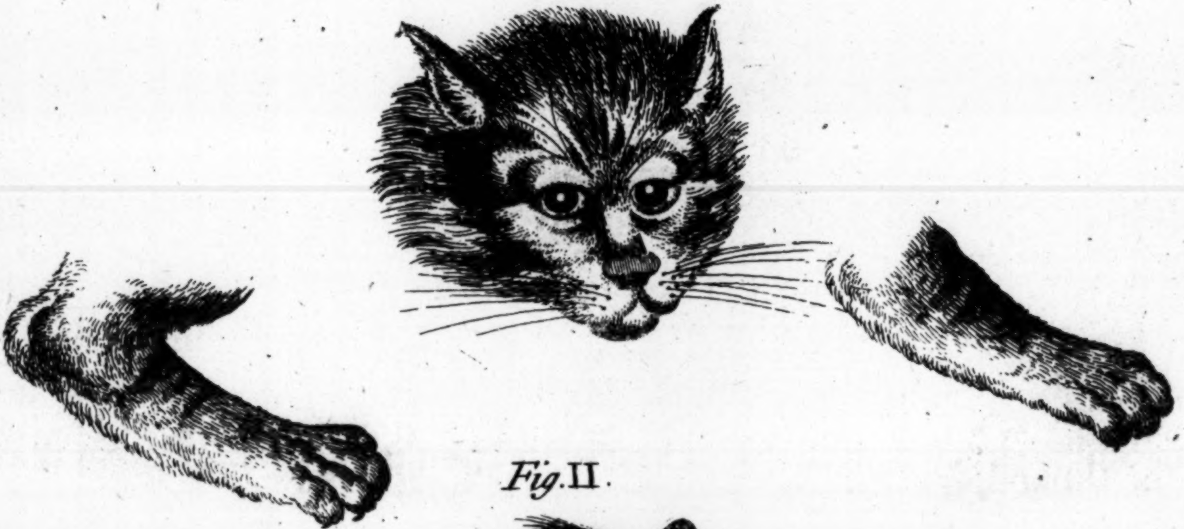
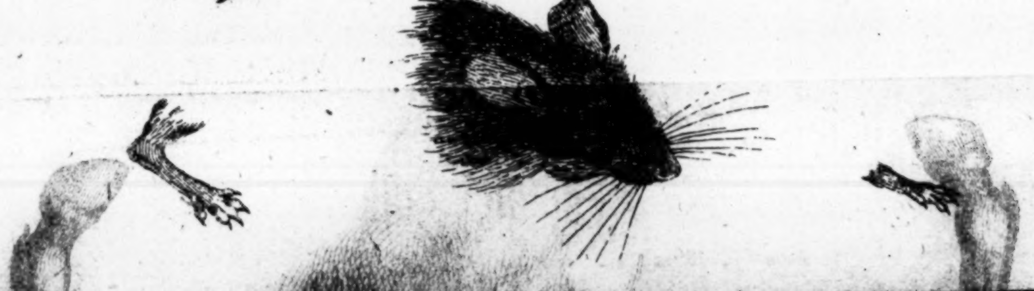


Fig. II.



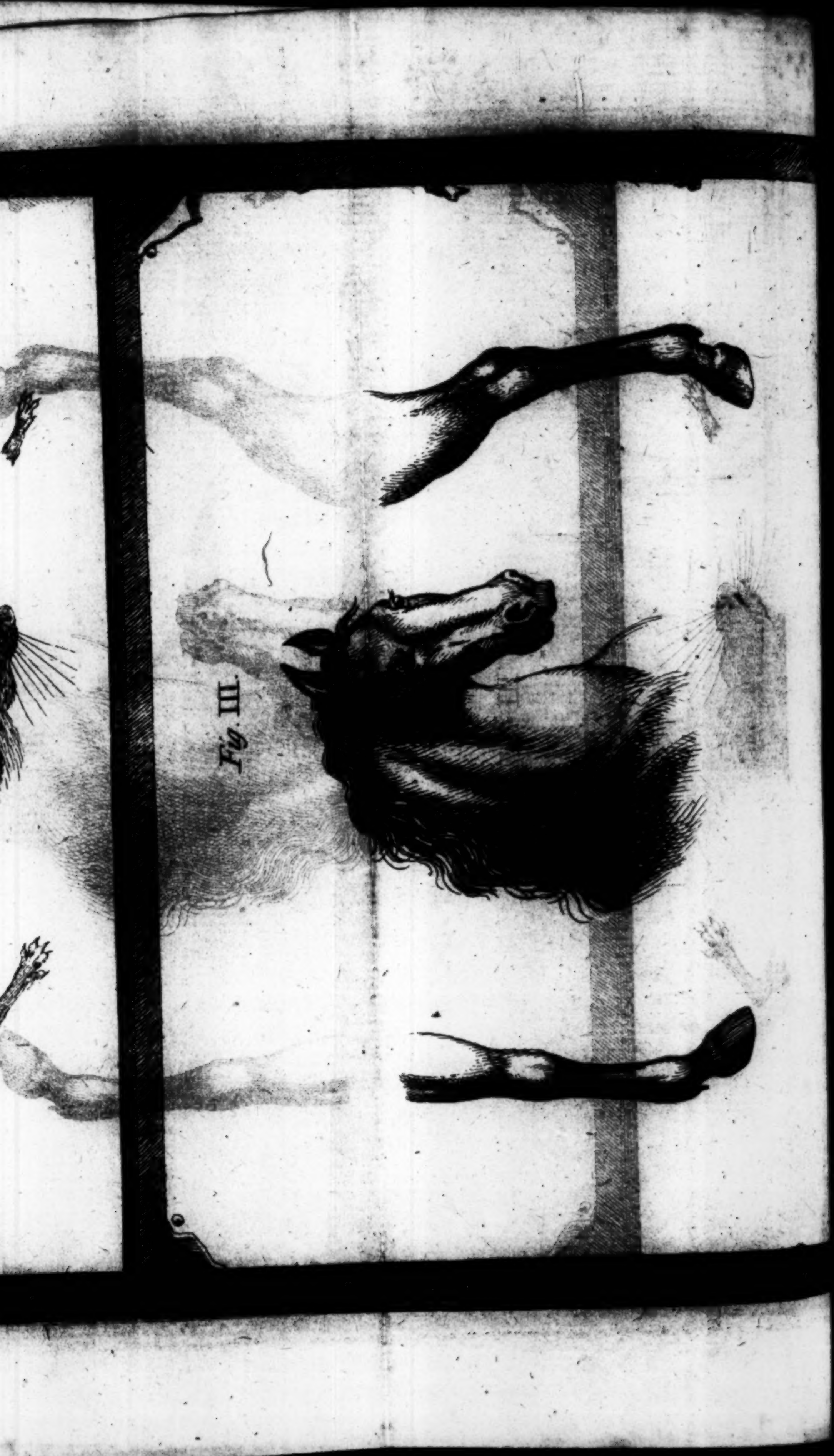


Fig. III.

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Ponds, and Rivers of little Reſort, whoſe Prey is chiefly upon *Fiſh*. And next theſe the *Seal* or *Sea-Calf* may well enough be placed, as it much more relates to *Quadrupedes* than the *Fiſh* Kind: It is *Viviparous*, and thinly clothed with *Hair*, and likewiſe ſuckles its Young; but its *Tail* and Fin-like *Feet* declare it to inhabit the Waters, for the moſt Part, being rather contriv'd for ſwimming than for walking or moving upon the Land.

Having now conſidered the principal Parts of *Quadrupedes*, and given ſome Account of their Uſes, we are next, in order, led to treat of ſuch four-legged Creatures, as are partly *Animal*, and partly *Inſectal*, ſuch as *Frogs*, *Toads*, &c.

Explanation of the Plates relating to Chap. IX.

PLATE XIV.

Fig. I, *The* Head *and* Legs *of a* Cat, *ſetting forth the Diſpoſition of thoſe Parts in moſt Beaſts of Prey.*

Fig. II. *The* Head *and* Legs *of a* Mouſe, *ſhewing the Difference between the* Claw-footed *and the* Talon-footed Beaſts; *as alſo the Diſpoſition of the Joints to help them in their Motion.*

Fig. III. *The* Head *and* Legs *of a* Horſe, *in which we may obſerve the Strength and Manner of its Jointing, and the whole* Hoofs *of a*

Horny *Subſtance, diſpoſed as well for its Defence as for hard Labour.*

PLATE XV.

Fig. I. *The* Man-Tiger; *from* Africa.

Fig. II. *A* Monkey *of an extraordinary Kind*; *from Mr.* Randal's *Collection, in* Channel-Row, Weſtminſter.

Fig. III. *The* Head *and* Legs *of a* Spaniel, *being a Continuation of the* Claw-footed *Kind.*

PLATE XVI.

Fig. I. *The* Head *and* Legs *of a* Hog, *being one of thoſe* Cloven-footed Animals, *without* Horns.

Fig. II. *The* Head *and* Legs *of a* Buck, *or a* Cloven-footed Animal, *of the* Annual Horned *Race.*

Fig. III. *The* Head *and* Legs *of a* Stag, *or the largeſt Kind of the* Cloven-footed Annual *Horned Race.*

PLATE XVII.

Fig. I. *The* Elephant, *brought from* Fort St. George *in the* Eaſt-Indies, *whoſe* Tusks *are not yet cut or budded. As the* Tusks *of this Creature always grow in the* Upper-Jaw, *I ſuppoſe them rather* Horns *than* Teeth.

Fig. II. *The* Head *and* Legs *of a* Goat, *or one of that Race with irregular twiſted* Horns, *which are* Perennial.

Fig. III. *The* Head *and* Legs *of a* Sheep, *being one of the Race which produces curled or twiſted* Horns.

Fig. IV. *The* Head *and* Legs *of a Bull, ſerving as an Example of the ſmooth* Horned *Tribe, whoſe* Horns *are* Perennial.

CHAP. X.

Of Frogs, Toads, *and ſuch Creatures as are partly* Animal, *and partly* Inſectal.

THESE Creatures are in ſome Reſpects like the *Animals* treated of in the preceding Pages, and in other Things are *analogous* to *Inſects:* They agree with the former in the Number of their *Legs*, and the Method of their Coupling; only that in theſe the *Males* and *Female* are joined for 3 Days, and the *Quadrupedes* already mentioned, are not ſo long in that Act. Their fleſhy Parts are like thoſe in *Animals* of the four-footed Kind; but the many different Changes they have between the *Spawn* and the *perfect Frog*, is as remarkable as thoſe in the *Inſect* Race. Again, the *Frogs* ſleep, or are laid up in the Winter, as are the longer-lived *Inſects:* And their different Degrees of Life, within and without the Waters, make them ſomewhat *analogous* to *Gnats*, which live their firſt Stage of Life in the Waters, and the Remainder of their Time in another Element.

The Difference between *Frogs* and *Toads* in *England* is very remarkable, tho' ſome will hardly allow any, which I ſuppoſe proceeds from their Want of Obſervation. They will have it, that *Toads* are no more than *Male Frogs*, or that all *Frogs*, which have black Backs, are thoſe which we ought to call *Toads*; but I hope to ſet them right in the following Accounts of both.

The *Skin* of our *Engliſh Frogs* is ſmooth, their Motion nimble and agile: One Sort has the *Skin* on the *Back* of a dark Colour, and the other is yellow, marked with Specks here and there. The *Skin* of the *Toad* is rough and knotted, and its Motion is heavy, dull, and crawling. The *hind* Feet of the *Frog* are webbed like thoſe of a *Gooſe*; and *Frog Spawn* are as large as *Peaſe*, and is brought forth in a Lump. The Feet of the Toad are not webbed, and its *Spawn* is ſmall, and chained together. *Toads* will live in damp ſhady Places, without ever entring the Waters; but *Frogs* cannot live out of Water. The Voice of the *Toad* is much coarſer than that of the *Frog*, and its Method of Life in many Things different. A *Toad* will live a long while in the Air-Pump, after the Air is exhauſted; but a *Frog* will die in leſs than half the Time. We have Inſtances of *Toads* that have been found in ſmall Cavities in the Middle of large Blocks of hard Stone. And I was once Eye-witneſs of a *Toad* which was ſawed out of the Center or Heart of the Trunk of a large *Oak*; but I have never yet heard of any *Frog* that was thus incloſed. It is reported, that an angry *Toad* will piſs a Sort of venomous Liquor, which is injurious to any living Creature it touches, but eſpecially to Mankind. I had once one of them, which ſpouted ſome of this *Liquor* in my Eye, but I received no Damage from it; perhaps, becauſe I immediately waſhed it with fair Water at a Pump; but we do not find that *Frogs* ever produce a *Liquor* of this Kind. It is common in *France*, and is now introduced among us, to eat the hinder *Legs* of *Frogs* as a great Dainty; but I have not yet heard of any that have been bold enough among the *Europeans* to feed upon *Toads*, unleſs ſome Mountebanks, who have done it to ſhew the Excellency of their Antidotes. I have often heard, that the People of *China* ſell *Toads* in the Markets, of a very large Size, and hold them to be great Dainties; but I ſuppoſe they are rather *Frogs* than *Toads*, and have only been thought to be of the latter Kind, for Want of Knowledge enough of the material Differences which we find in one and the other. Upon the *Alps* there is a Kind of *Toad* about four Times larger than our *Engliſh Toad*. And I have ſeen in the Cabinets of Mr. *Seba*, and Dr. *Ruyſh* of *Amſterdam*, many Kinds of them well preſerved, and great Variety of *Frogs* with long *Tails*, curled *Ears*, and their *Backs* marked with various Figures. In the *firſt* of theſe Cabinets there is a remarkable Set of *Frogs*; which, from the Form of the common *Frog*, differ in the Frame of their Parts gradually, till the laſt is of the Figure of a *Fiſh*. I ſhall now account for their *Generation*, and of their gradual Alterations from the *Spawn*, till they become *perfect Frogs*, as it was obſerved by that accurate Anatomiſt, Dr. *Douglas*, F.R.S. to whom I am likewiſe obliged for the following Relation.

Of the curious Structure and Conſtitution of the Genital Parts *in a* Female Frog, *full of* Eggs.

Of all the conſtituent Parts of this Animal, there are none more artfully contrived, nor ſo curiouſly framed, as thoſe that ſerve for propagating the *Species* in both Sexes, but eſpecially in the *Female*; and from the great Analogy and Likeneſs that is between *theſe*, and thoſe in *Women*, we may draw a moſt convincing Argument to ſtrengthen and inforce their Opinion, who maintain the Syſtem of the *Eggs*.

2 *Ovaria*, 2 *Oviductus's*, and 2 *Uterus's*, are the Parts to be deſcribed.

The *Ovaria* are two large *veſicular Bags*, formed of a thick glandulous *Membrane*, with a *Cavity* a *Cavity* within very apparent, if you diſtend them with Wind.

Each *Ovarium* is placed about the Middle of the *Abdomen*, laterally on each Side the *Spine*, being faſtened by *Blood-Veſſels* and *fibrous* Connexions to the *Meſentery*, upon the upper Part of each *Kidney*.

Their Bigneſs varies according to the Number and Magnitude of the *Eggs* they contain; for juſt after they have dropt off, they look flaccid, being contracted into a narrow Compaſs, feel ſoft and ſlimy, and appear of a yellowiſh Colour, having a Number of little black Specks or Points here and there intermixed; but when the *Eggs* are come to their Maturity and full Ripeneſs, they are very large, and look of a *black* Colour ſpotted with *white*, very much diſtending the *Belly*.

The *Tubes* or *Oviducts* are two long *Channels* or *Pipes*, lying on the Sides of the *Belly*, between the *Lungs* and the *Uteri*. In their natural Situation they are rolled up and faſtened together by a *Membrane*, as by a *Meſentery*, making ſeveral anfractuous *Gyri*, or winding Circumvolutions, not unlike the ſmall Guts in little *Birds*.

Theſe, as well as the *Ovaria*, differ in Bigneſs and Colour, according to the Seaſons of the Year, and different Times of Geſtation; for juſt after all the *Ovula* are paſſed, they are ſlender, and very ſmall, of a yellowiſh Colour: However, if they be thrown into the Water, they ſwell and become ſomething bigger: But juſt before the *Ovula* are looſened, they are as big as a *Gooſe-quill*, of a whitiſh Colour; and if they are then thrown into Water, they will, in the Space of *one* Night, ſwell ſix times bigger, and in a little time after they will diſſolve into a kind of Mucilage or Jelly. The Inſide of theſe *Tubes* are covered with a thick, ſlimy, glutinous Matter, which beſmears the *Ovula* in their Paſſage, and afterwards ſerves for a *Nidus*, if not for Nouriſhment alſo, to the little *Animals* or *Tadpoles*, all whoſe perfect *Lineaments* are wrapped up and contained in theſe *Ovula*, as it were in Miniature; ſo that when all that *ropy*, *viſcid Gluten*, ſeparated there by the *Glands*, is rubbed off, they muſt needs leſſen in their Bulk.

The Beginning of each *Tube* is upon the *Septum Tranſverſum*, juſt under the *Lobes* of the *Lungs* near the Heart; it opens by a pretty large *Orifice*, and its Subſtance, for about half an Inch, is membraneous, with ſome *Striæ* or *Ridges*, appearing upon it.

The *Uterus* is made up of a very thin and tranſparent *Membrane*, being divided into 2 diſtinct *Cavities* by a *Septum*, and each of them opens by a particular *Orifice* into the *Rectum Inteſtinum*, which paſſing over this *Bag*, braces it down, and makes it bulge out on each Side.

When the *Ovula* are come to their full Maturity, they are detached from the *Ovarium*, and nd being looſened, they fall into the *Cavity* of he *Abdomen*, where they float about for ſome Time, till by the Motion of the *Sterum* and abdominal *Muſcles*, being much aſſiſted by the onſtant and long Compreſſion of the *Male Frog*, (which, according to the Obſervation of the urious *Swammerdam*, rides upon the Back of he *Female* 40 Days, cloſely embracing, and laſping round its Body with His *Fore-legs* under Hers, joining His *Claws* upon the *Sternum*) being received into Her gaping *Orifice*, the ſame Motion does forward its Progreſſion to the *Uterus*; and it is not improbable, but the *Tube* itſelf may have ſomething of a Vermicular Motion, which may be of uſe in propelling the ſame. After they have been ſome time in the *Uterus*, they are diſcharged, *ſtatis temporibus per Annum*, the *Male* being ready, at that very Inſtant, to beſprinkle them with his *Semen*, in order to impregnate and render them fruitful.

We find in the common *Female Frog*, that the *Ovaries* ſpread themſelves almoſt over her whole Back, and even reach within a very little of the *Head*; which I believe is common to all the *Frog* kind, altho' they do not always produce their Young after the ſame Manner. The curious *Surinam* Frog, which Madam *Mariana* of *Amſterdam* has publiſhed in her *Hiſtory* of *Surinam* Inſects, brings its young ones perfectly framed into the World, after they are hatched in certain Cells, within the *Skin* of the *Back*. Sir *Hans Sloan* has one of theſe Creatures in his

Cabinet; and we may find more of the ſame in th Collections of Mr. *Vincent* at *Harlem*, Dr. *Ruyſ* and Mr. *Seba* of *Amſterdam*, and at the Phyſic Garden in that City, in which Cabinets of Raritie I have obſerved this *Frog* in 3 different States, 1ſt, the *Pores* of the *Back Skin* were all cloſed, excepting 3 or 4, which began to be forced open by the *Eggs* lodged in Cells below them: The 2d had all the *Pores* in the *Skin* of the *Back* ſo much opened, that I could plainly diſcern the Points of the *Eggs* within them; and the 3d had young ones in the Figure of the XXIId *Plate.* I chuſe rather to rank it with *Frogs*, as it is Web-footed, and an Inhabitant of the Waters, than place it with the *Toad* Race.

From what we have here ſaid, it appears that *Frogs* and *Toads* partake of many Qualities obſervable in *Inſects*, tho' not in every Reſpect; but as they agree with them in ſome Particulars, I ſhall next conſider thoſe *Inſectal* Bodies, which may be ſtiled irregular *Inſects*.

Explanation of the Figures relating to Chap. X.

PALTE XX. A.

In this Figure I. A *the* Parts *of* Generation *in* an English Female-Frog *are delineated, being firſt taken out of the Body, and then expanded.*

A:A: *The* Tuba Uterina *or* Oviduct *ſeparated from its Connections, and drawn out to its full Length.*

1. *Its upper* Orifice.
2. *Its Opening into the* Uterus.
3. *Some of the* Ovula *ſticking in its* Cavity.
4. *Part of the membraneous* Meſentery *left on.*
5. *The Circumvolutions and Windings of the* Tube.

C. *The empty* Ovarium.

D. *The* Uterus *diſtended with* Eggs *or* Spawn, *appearing of a* blackiſh *Colour at the Sides, but* whiter *in the Middle.*

E. *The* Inteſtinum Rectum *cut open, and turned back on the Sides of the* Uteri.

6. *The ſmall* Orifice *or Opening, by which the* Ovula *paſs from the* Uterus, tempore partûs.
7. *The* Spincter Ani.
8. *The* Levator *of the ſame.*
9. *The* Veſica Urinaria *divided and laid back.*

PLATE XX. B.

In this Plate *are repreſented, in* 17 *Figures, drawn from the Life, the ſlow and gradual* Epigeneſis Ranarum; *that is, all the remarkable Changes, and the ſeveral Gradations that are obſerved in the Growth of a* Frog, *from the* Ovum, *or* Spawn, *to a compleat and perfect* Animal.

No. 1. *Exhibits an* Ovum *juſt ſpawned, and taken out from the Heap, or as it appears when it* *it drops from the* Uterus *in a Cluſter, having a round* black Speck, *or* Punctum nigricans, *in the Middle, which is the firſt Rudiments of the* Tadpole: *The Outſide of this* Spot *is of a* whitiſh *Colour.*

No. 2. *Shews the* Ovum, *after it has lain ſome Days in Water, ſurrounded with its Gluten, or a viſcid, glewy Subſtance, commonly called* Sperma Ranarum, *or* Frogs Spawn.

No. 3. *Here the* black Speck *has changed its Round Figure into an Oval One, being curved, and ſmaller at one End than the other.*

No. 4. *In this, the* Gyrinus, *or little* Animal, *is grown bigger, and the* Pellicula, *or thin* Membrane, *that contains the viſcid Subſtance, appears ragged and tore, as if Cobwebs hung to it.*

No. 5. *The glutinous Humour, that in the preceding Figure was ſmooth and even, appears in this to be hollow, like a ſtoned* Raiſin.

No. 6. *Shews the* Gyrinus (*which now has put on the Shape of a* Vermiculus, *or little* Worm, *called properly a* Tadpole, *and by our Country People a* Bull-head) *ſticking by its Mouth to the glutinous, alimentary Subſtance. After the* Vermiculus *had undergone this Change, I firſt obſerved it to move its* Tail, *and become a living* Animal.

No. 7. *Here we have exhibited the little* Tadpole *detached and freed from the viſcid Matter, that not only ſerved for its Nouriſhment, being received in at its Mouth, for it* *had nothing analogous to the* Vaſa Umbilicalia, *to convey it that way, but alſo for a Bed to lie on while weak and tender: Here are likewiſe obſervable, a* Head, Body *and* Tail, *with two little ſharp Points near its* Head.

No. 8. *Repreſents our* Gyrinus *much bigger, with a thicker* Head *and* Body, *and a long narrow* Tail; *and being touched, was able to move itſelf in the Water very nimble and quick, like a ſmall* Eel; *and from this frequent whirling round in the Water, this little Creature is named as above.*

No. 9. *In this* Tadpole, *you may perceive ſome of the Windings and Circumvolutions of the* Guts, *through the thin tranſparent* Skin, *and other Integuments of the* Belly.

No. 10. *By this Figure, the ſame* Animal *is repreſented in a different View, in which it appears to be leſs than the former.*

No. 11. *Here we may with Pleaſure obſerve the two* hinder Legs *ſenſibly budding out: The* Tail *which, like a* Rudder, *ſerves to ſteer or move its little* Body, *is very large; the Sides or Edges of it are thin and tranſparent; and down its Middle there runs a thickiſh hard Subſtance of a browniſh Colour.*

No. 12. *In this View, we ſee the* hind Feet *longer, one of the* Fore-legs *half out, and the other juſt beginning to protuberate through the* Skin.

No. 13, 14, 15. *Do all repreſent the* T *gradually grown bigger.*

No. 16. *Here the* Gyrinus, *or* Tadpole, *i now undergoing its laſt Change; and as ſoon a the* Tail, *which is now almoſt wore off to Stump, is quite loſt, it aſſumes the Denominatio of a* perfect Frog, *which*

No. 17. *Repreſenteth to our Eye.*

PLATE XXI.

Fig. I. *The* Frog *fully perfected.*
Fig. II. *The common* Engliſh Toad.

PLATE XXII.

Fig. I. *The* Surinam Frog, *ſhewing the Manner of its bringing its young ones, perfectly formed, out of the* Pores, *in the* Skin *of its Back.*

CHAP. XI.

Of SNAILS, EARTH-WORMS, CENTIPEDES, MILLEPEDES, SPIDERS, *and* Inſects *without Wings, which may be ſtiled* irregular *Inſects.*

THESE *Inſects* have very ſurpriſing Particulars, differing almoſt in every Thing from all other created Bodies. The *Snails*, which I ſhall firſt treat of, have indeed ſome

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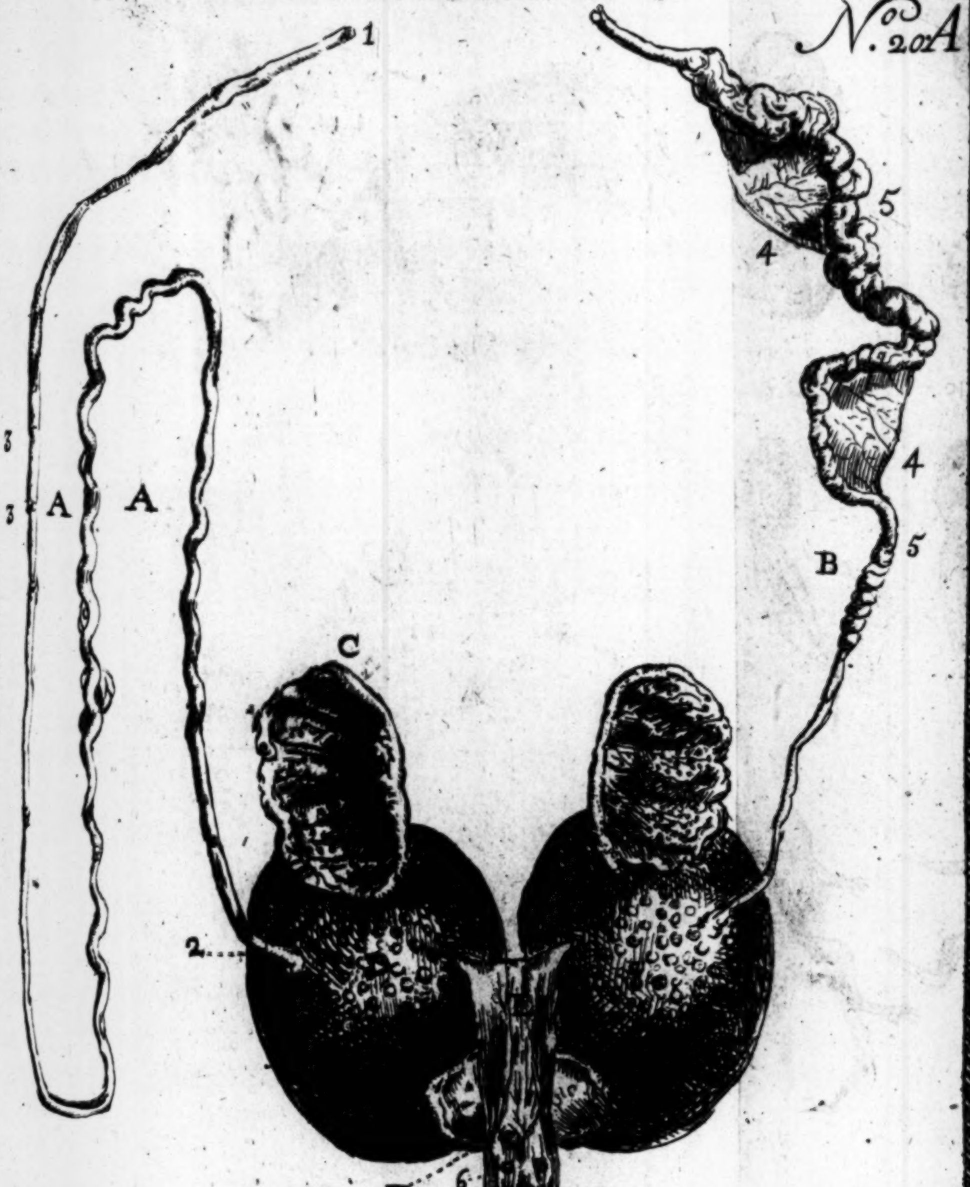

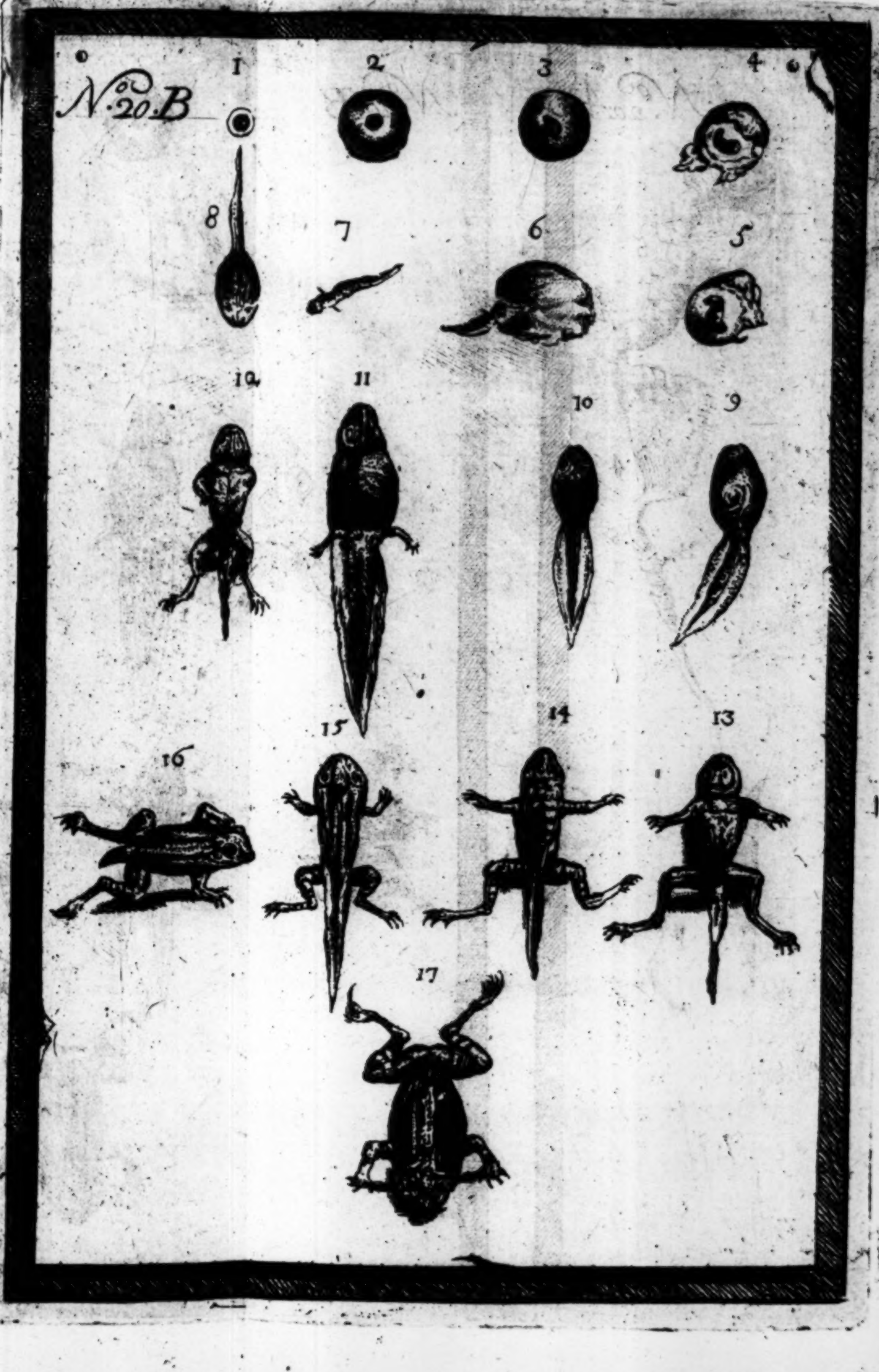
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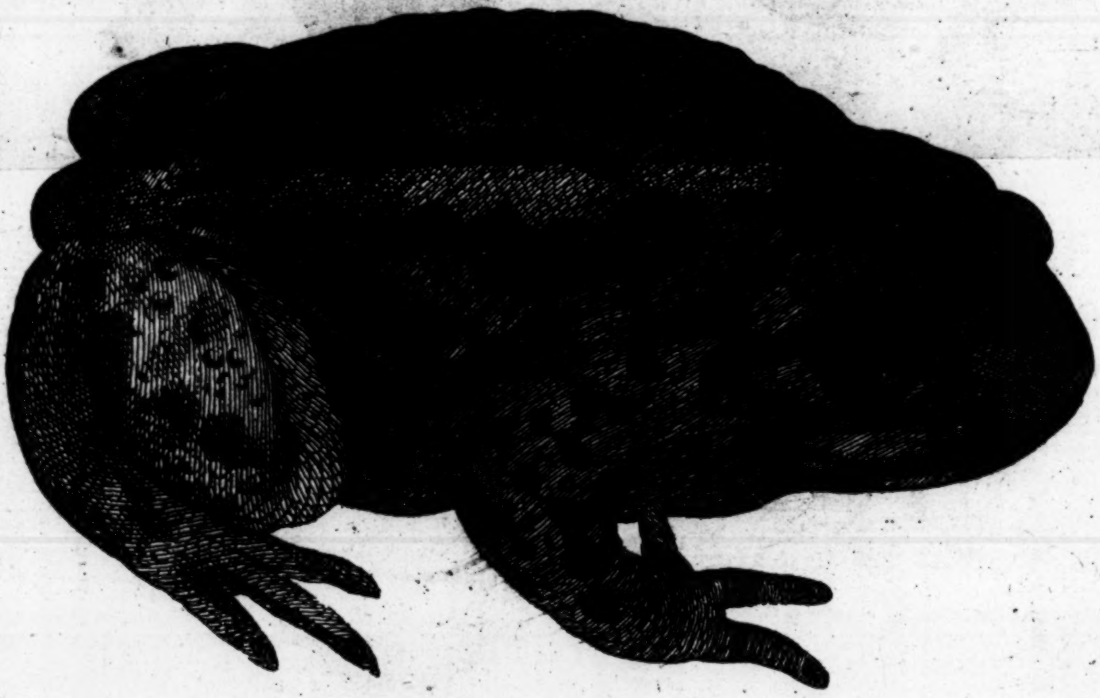


Plate XXI.

Fig. I.

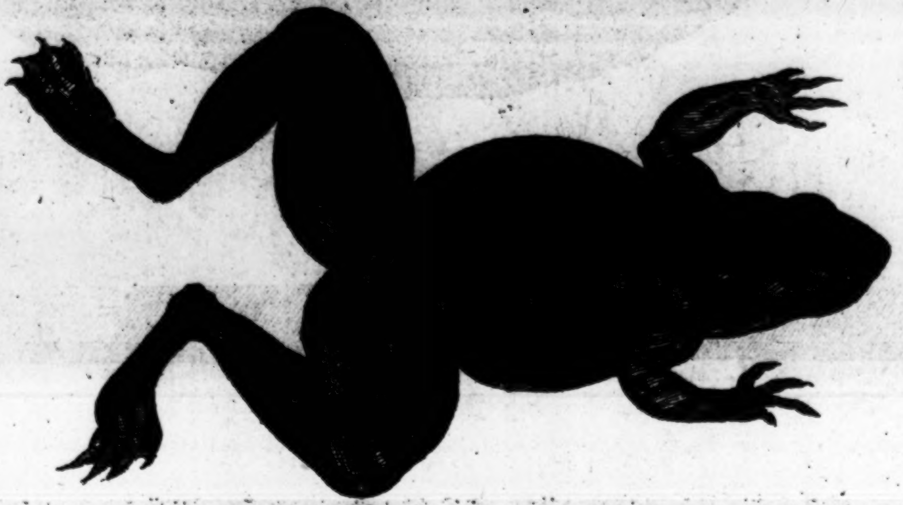
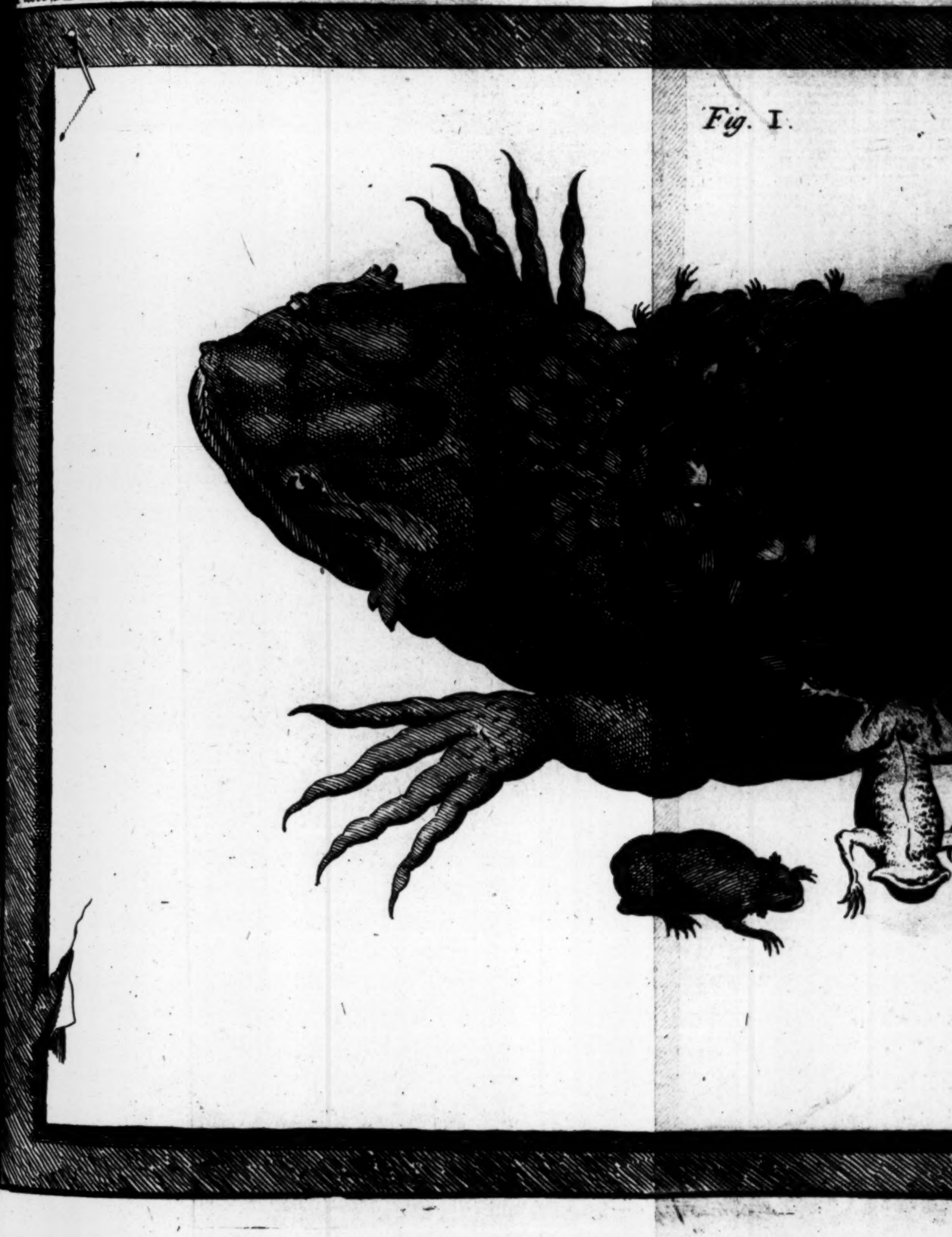


Fig. II.

Plate XXII.



J. Cole Sculp.

ne little Affinity to *Animals*, ſuch as the
tching of their young ones at once perfectly
rmed. They are *Oviparous*, but the Manner
their Coupling is extraordinary: Every ſin-
e *Snail* poſſeſſes the *generative Parts* of *both*
xes, and makes uſe of them equally when
ey couple: The Situation of theſe Parts is on
e left ſide of the Head; but are only to be diſ-
vered when they are *generating*, which is a-
ut the Middle of *May*. They remain in Copu-
ion about 12 Hours, and are then hardly to
ſeparated without wounding their Parts. A-
ut 3 Weeks after this Act is over, they make
eir way into the Earth, and lay their *Eggs* in
nots of about 30 in Number, near 4 Inches deep;
r this they commonly make choice of a moiſt,
ady Place, in which Station their *Eggs* are hatch-
l in about a Month, and young *Snails* then appear
ove Ground. The Manner of their meeting
couple is well worth obſerving; in *dewy* E-
nings, or after a Shower of Rain, they crawl
pon the Graſs in a circular manner, making
veral Rounds, till they come near enough to
ne another to accompliſh their Deſign; I have
bſerved them ſometimes make above 20 Turns
efore they could join. The *Dew Snails*, and
hat Gardeners call *Slugs*, have all of them
he ſame Mode of *Generating* as we obſerve
n the *Shell Snail*, which is of ſeveral Kinds
ith regard to the Conſiſtency of their Fleſh, and
he Colour and Variegation of their Shells; but
pon their firſt hatching they are ſo very tender,
hat the Weight of a few Grains would cruſh
them

them out of Form ; and it is hard at that tim to make any Diſtinction between the differe Kinds. Their Fleſh is of a Spungy Textur and the Juices which afford it Nouriſhment a viſcous ; which I ſuppoſe may be one Reaſon wh the Motion of *Snails* is ſo very ſlow, that Kin of Juice being of too thick a Subſtance to circu late quickly. I have been informed, that th moſt Intenſe Cold, which can be produced either by Nature or Art, cannot freeze the Juic of *Snails* ; but I think all *viſcous* Matter is har to be congealed ; for I do not find that *Birdlime*, if it is in any conſiderable Body, wi freeze, if it be expoſed to the coldeſt Air, no more than the *Berries* of the *Miſletoe* or *Viſcum*, whoſe Seaſon of Ripeneſs is in the coldeſ Time of the Winter ; but other *Seeds*, whoſ Juices are more *aqueous*, are ſpoilt by a littl Froſt. The Food of all this Race is tende *Leaves*, and young *Sprouts of Plants*, which they devour, by means of a Tooth-like Body growing in their upper Jaw, with which they rather ſcrape the *Leaves* to pieces than macerate them ; for there is no Sign of any Teeth in their lower Jaw. In the XXIIId Plate I have given a Figure of the *Teeth*, but eſpecially of the generative Parts, as they apppear at the Time of their Coupling ; both done with a *Microſcope*.

The better to diſcover the Degree of Life in theſe Creatures, whoſe Circulation of Juices ſeems ſlow enough to come nearer to a State of

Stagnation, than the Motion of Juices in other Animals, I have endeavered to find out the Situation of the Heart, and to compare its Motion with the *Beats* of a *Pendulum*. The firſt Subject I met with, which gave me the View of this Part, was a ſmall *Snail* juſt hatched, whoſe *Body* and *Shell* were ſo tranſparent, that I could diſcern its *Beats* to be diſtant about 3 Seconds; but as I ſuppoſed the Juices in this were much more fluid than in the older *Snails*, I had recourſe to ſome of the largeſt I could find; but their *Shells* not being tranſparent, I was obliged to take them off as well as I could, without wounding the *Snails*, and then on their left Sides I plainly diſcovered the *Beats* of the Heart to be about 5 Seconds diſtant from one another, and 3 Hours afterwards about 7 Seconds, tho' ſome of them were then ſtrong enough to begin the renewing of their *Shells*, which they effect, by flinging out a large Quantity of *viſcous* Matter thro' the Pores of that Part of the Body which had been incaſed before. The Motion of theſe Creatures is performed by repeated Undulations of their fleſhy Parts, without the Help of any *Feet* that I can diſcover; this undulating Motion preſſes a *viſcous* Matter out of their Pores, which ſerves to faſten them to any thing they crawl upon, and helps them in their creeping up the Sides of *Walls* or *Trees*, and even when they reverſe their Bodies, and creep upon *Cielings* with their *Shell* downwards. But it is obſervable, that a *Snail* ſeldom has any Motion but when it is in ſearch of Food, or is about Generating, and then it is only when the Ground is wet, and it has Opportunity of ſupplying its loſt Juices by freſh Food. I have remarked, that when a *Snail* is obliged to paſs over a dry duſty Place, it loſes ſo much of its *viſcous* Juice, that it can hardly recover it again.

I now proceed to the *Earth-Worm*, whoſe Shape is long and round, and their Bodies compoſed of ſeveral *Annuli*, jointed in one another, upon ſome of which, ſome curious Men have obſerved little *Feet* or *Aſperities*, with which it is ſuppoſed they take hold of the Ground as they creep along. This *reptile* Motion, as Dr. *Tyſon* obſerves, may be explained by Wire wound on a *Cylinder*, which when ſlipt off, and one End extended and held faſt, will bring the other nearer it. In this manner the *Earth-Worm* having ſhot out or extended its Body, (by a ſort of wreathing) it takes hold of the Ground with its ſmall *Feet*, and ſo contracts the hinder Part of its Body. Theſe Creatures cannot bear Heat any more than the *Snails*, and ſeldom are ſeen out of the Earth but when they are diſturbed, or when a Dewy Evening or wet Weather invites them to couple; and even then they do not entirely quit their Holes, but extend their Bodies as far as they conveniently can to reach one another, and couple much after the ſame manner as *Snails*, *i. e.* by performing each of them the *Male* and *Female* Duty. But I have not yet been nice enough in this Enquiry, to determine whether they are *Oviparous* or *Viviparous*.

I ſhall next take notice of *Jointed-Worms* with many *Feet*, which are called *Centipedes* and *Millepedes*: Theſe have always their Habitation in ſhady moiſt Places, chiefly in rotten Wood, and under Logs, or amongſt Rubbiſh. Our *Engliſh* Kinds of *Centipedes* are about 2 Inches long, conſiſting of about 30 *Joints*, every one of which has 2 *Legs*, as ſmall as *Hairs*, ſo that they have in all about 60 *Legs*, which they move alternately; and yet for all this mighty Number are but ſlow in their Motion, compared with other *Inſects*. In the *Weſt Indies* there is a kind of *Centipes* about 8 Inches long, when it is full grown, whoſe Figure I have taken from the Royal Society's Collection; but how theſe Creatures are produced, I have not yet had an Opportunity of obſerving, any more than the Generation of thoſe Creatures called *Millepedes* or *Wood-lice*, which, tho' they bear that Name, have not above half the Number of *Legs* that we obſerve in the former. Their Bodies are covered with *Jointed Scaly* Subſtances, which give them ſomething of the Figure of an *Armadillo*; but I never obſerve the Parts of theſe to alter as thoſe do among the regular *Inſects*, which I ſhall treat of in the next Chapter.

I come now to mention the *Spiders*, another Tribe of *Inſects* which is very numerous, there being above 140 different Kinds of them in *England* only, as the curious Mr. *Dandridge* of *Moorfields* has obſerved and delineated. It is obſervable in this Race, that they are all wanting of that Part which we might properly call the *Head*. As the Bodies of regular *Inſects* are commonly divided into 3 Parts; the *Head*, the *Stomach*, and the *Tail*; theſe, for the moſt part, have their Bodies divided only into 2, reſembling as it were the Bodies of *Bees* or *Waſps* without their *Heads*; but about the Place where the *Head* ſhould be ſet upon the Bodies of *Bees* or *Waſps*, i. e. the Paſſage immediately into the Stomach, we obſerve 2 *Feelers* or *Antennæ*, with Tooth-like *Jaws*, for the pinching and macerating their Food. Upon the Upper Side of the ſame Part we diſcover their Eyes, which are commonly 8 in Number, and differently placed, as the *Spiders* are of different Make. The *Long Legs*, which is of this Tribe, has its Body undivided, and no Sign of any *Head* any more than the reſt. Mr. *Dandridge* obſerves, that this Kind has but 2 *Eyes*; and I have not remarked that it is fond of Motion, but remains conſtantly in the ſame Place where it is hatched, unleſs it be provoked or diſturbed. It is remarkable that all our *Engliſh Spiders* have 8 *Legs*; but thoſe which come from the *Weſt Indies* have 10. Among *Spiders* we may farther obſerve, that as they are of different Claſſes, they have different Modes of Motion, and of catching their Prey; one of the ſmaller ſort jumps from Place to Place; another Kind, after running about a Yard, makes a full ſtop, and then running about the ſame Length ſtops again; others are ſo very quick and continued in their Motion, that they will run about 10 Yards in 2 Seconds. Again, we may remark, that ſuch Kinds as have *Webs*, have different Manners of compoſing them; ſome of them are of the Figure of a Tunnel-Net, diſpoſed for catching all kind of *Flies* that come into it, the *Spider* himſelf lying out of Sight: Theſe Kinds are commonly found in Houſes, and are more voracious than any of the other Kinds. Another Sort makes his *Web* almoſt of the Figure of a Caſting-Net, and places himſelf always in the Center. The Regularity and artful Contrivance in its compoſing this *Web*, together with its ſurpriſing Manner of paſſing from *Bough* to *Bough*, without any Help but the Air, to lay its *Foundation Threads*, is well worth our while to obſerve, and perhaps may have given ſome Aſſiſtance to the Inventors of Weaving or Knitting.

We have many Accounts of the Flight or Sailing of *Spiders* in the Air, by Means of their *Webs* or *Thread*; but I have not yet had an Opportunity of obſerving it. I have meaſured the *Webs* of ſome of the larger Kind of *Spiders* in *England*, in one of which there was above 48 Yards of *Thread*; another contain'd about 46. It appears by Mr. *Dandridge's* Collection that we have but 9 different Claſſes of *Engliſh Spiders*; one of each Claſs is in the 24th Plate, wherein I have alſo given a Cut of the *Tarantula*, taken from that in the *Royal Soeiety*, which *Spider* is ſaid to be venomous, and has given Riſe to many Relations, which I account fabulous; but there is no Creature of this Race which I eſteem more extraordinary than the large *Weſt-Indian Spider*, which meaſures ſometimes above

5 Inches over, as may be ſeen in Dr. *Ruyſh's* Cabinet at *Amſterdam*. It has 10 *Legs*, covered with long brown *Hair*, which gives it a very frightful Aſpect. It is ſaid that the *Web* of this *Spider* is ſtrong enough to catch the *Humming Birds*, which it preys upon.

Among theſe *Inſects*, I cannot help mentioning the *Ant* or *Piſmire*, whoſe Induſtry and Cunning may afford us ſufficient Matter for Obſervation. It is one of thoſe *Inſects* which either ſleeps the Winter, or is laid up at that Time; but I rather believe the latter, becauſe of its Care in providing and hoarding Food. There are ſeveral Sorts of *Ants*, ſome of which are larger than our common Houſe *Flies*; theſe are called *Horſe-Ants*, and are ſeldom fewer than 5 or 6000 together: Their Habitation is commonly under the *Roots* of great *Trees*, where they may beſt live undiſturbed. They feed commonly upon dead *Inſects*, or *Carrion*, like the common ſmall Kind, and ſeem to agree with them in every reſpect but their Size. If we open one of their *Neſts*, we diſcover Galleries and Paſſages in ſeveral Ranges one above another; but yet all ſo diſpoſed, as to have a free Communication one with another. It is obſervable among theſe Creatures, that if any of their own *Brood* happen to be killed, they immediately remove him from their Habitation; and if they meet with any dead *Inſect*, or other proper Food in the Courſe of their Travels, they find means to bring it home, altho' it be very diſtant from their Apartments. There is no better Way to prepare the *Skeletons* of *Mice*, and other ſmall *Animals*, than by fixing thoſe Creatures in a right Poſture in a little Box with Holes in it, and burying it among theſe *Ants*, which, in a few Days, will clear the Bones of all the Fleſh; ſo that they are able to perform what the fineſt Knife in the World can ſcarcely execute. This Sort of *Ant*, as well as the ſmalleſt Kind, is hatched from an *Egg* about *June* or *July*. I have obſerved, that by Sun-Riſing, the whole Colony is employed in bringing up their *Eggs* to the Surface of their Hill, that they may be within the Reach of the Sun's Warmth; but as ſoon as the Sun begins to decline, they renew their Labour, and return their *Eggs* to the loweſt Caverns, to lie ſafe from the Evening Cold; and this they do every Day when the Weather will permit, till their young ones are hatched. Some among them have *Wings*, and thoſe leave the reſt in a few Days to ſeek ſome other Habitation. It is remarkable, that the common ſmall *Ant* will often frequent Houſes in ſearch of their Food; and if they are lucky enough to find out Sugar or Sweet-meats, their whole Tribe are ſoon apprized of it, and follow them to the Place. A noble Lord gave me a remarkable Inſtance of it: A *Neſt* of theſe Creatures in his Garden diſcovered a Cloſet of Confections many Yards within the Houſe, and had a conſtant Recourſe to it, by a certain Road which they traced out through two Rooms, which they obſerved ſo exactly, that they hardly varied an Inch from it; and what is moſt remarkable, theſe Creatures continued for ſome Days the ſame Route, notwithſtanding the ſweeping and cleaning of the Rooms they paſt thro', till the whole *Neſt* was deſtroyed.

I have obſerved one Sort of *Ant* which lays its *Egg* in the Back of the *Oak Leaf*, and raiſes the Bliſters in thoſe *Leaves*, which we call the *Oak Berries*. Thoſe *Berries* are round, and about the Bigneſs and Conſiſtency of a half grown *Grape*: In every one of theſe is a ſingle *Inſect* perfectly formed; ſo that it appears it has no Change after hatching.

I ſhall conclude with the *Ear-wig*, which we have not yet remarked to have any Change of Figure after it is once hatched; but only when it is full grown, we may diſcover its *Wings* folded up in ſmall Caſes upon the Middle of its Body, as may be obſerved at Mr. *Dandridge*'s. I ſhall proceed to conſider thoſe *Inſects* which we may call *regular*, ſuch as the *Papilionaceous*, *Bee*, and *Fly* Kinds.

Explanation of the Plates relating to Chap. XI.

PLATE XXIII.

Fig. I. *A* Land Snail *in a creeping Poſture.*

Fig. II, *The* Teeth *of the ſame* Snail *in the* Upper-Jaw, *done with a* Microſcope.

Fig. III. *The* Male *and* Female *Parts of* Generation *in the ſame* Snail. A: *The* Orifice *of the* Female *Part*. B: *The* Tube *of the* Male *Part.*

Plate XXIII

Fig. I

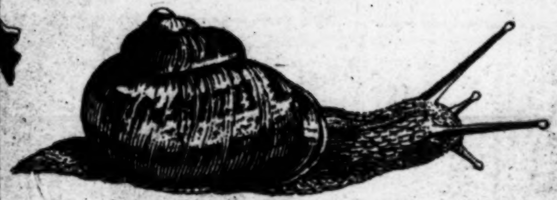


Fig. II.

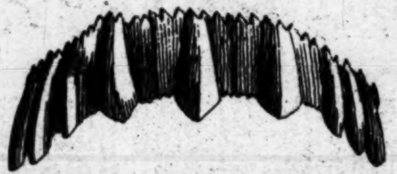


Fig. III

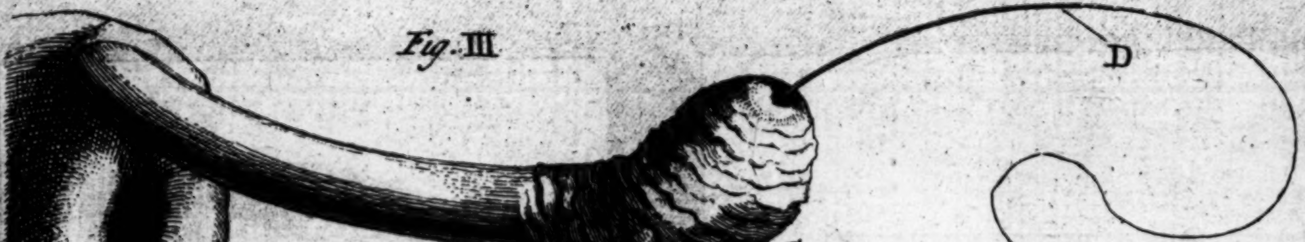
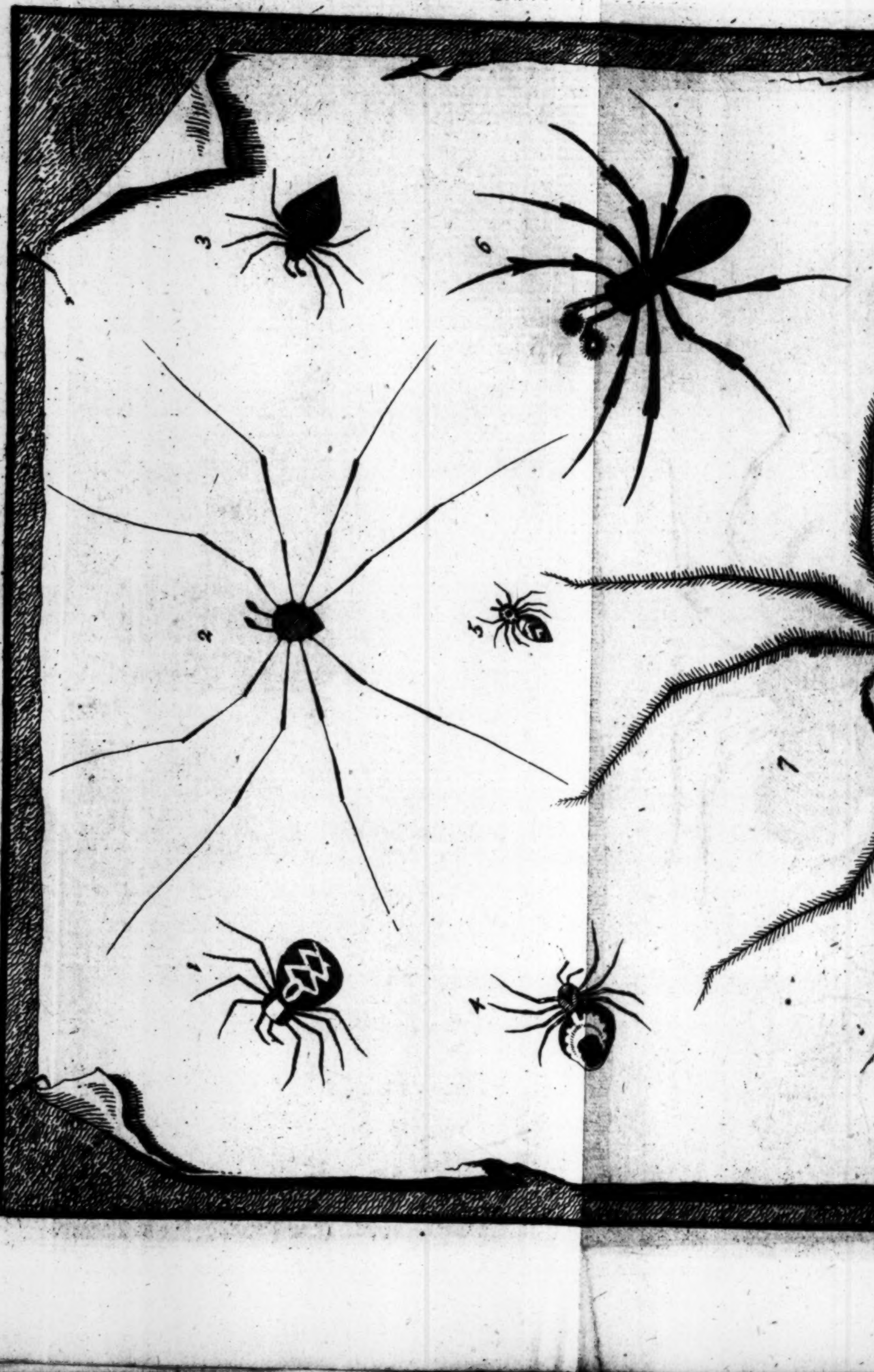
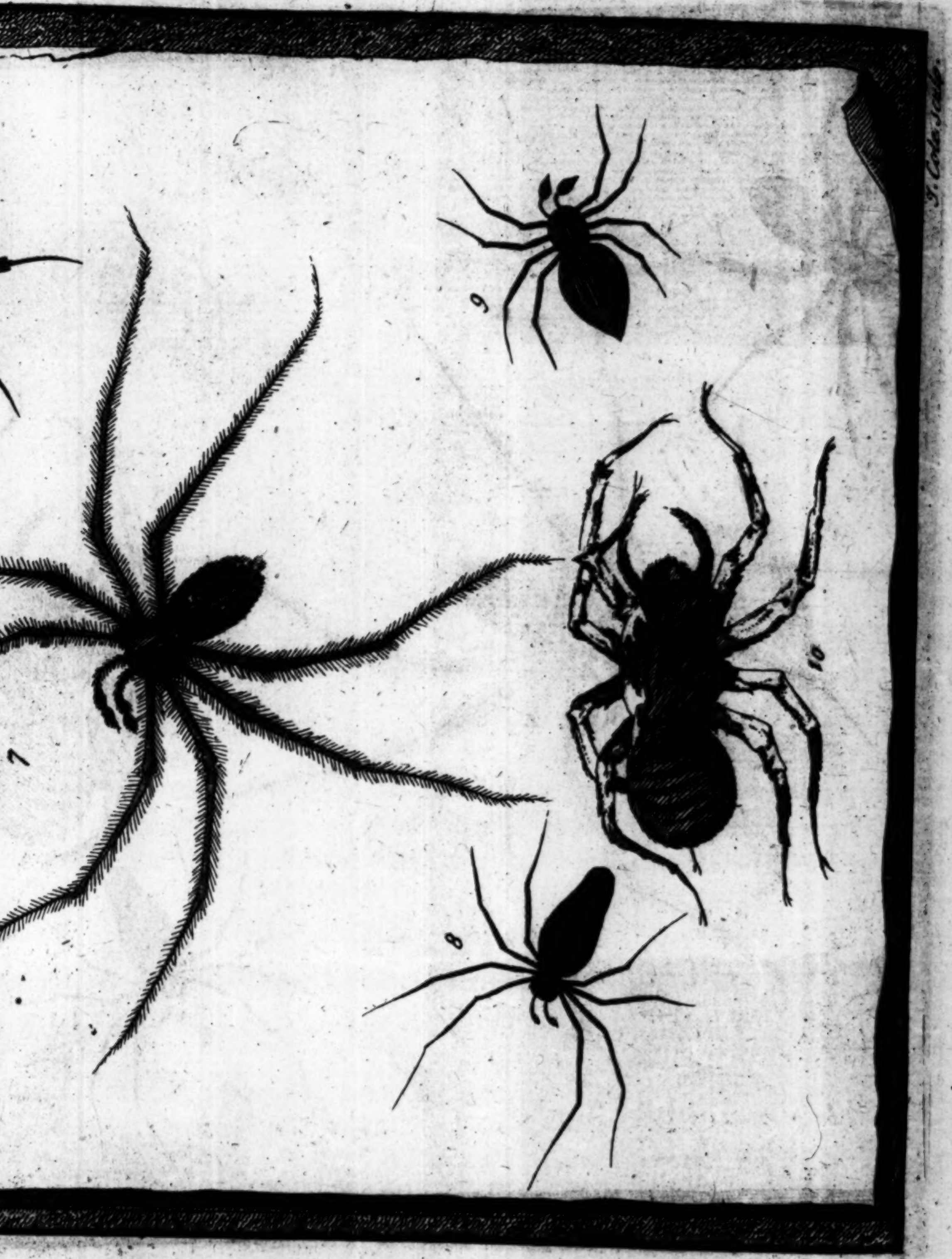


Fig. IIII

J. Cole sculp.

Plate XXIV.





9
10
7
8
J. Cole sculp.

Part. C: *The* Glans *of the ſame.* D: *A wire-like Subſtance proceeding from the ſame; done with the* Microſcope.

Fig. IV. *A* Snail *diveſted of its* Shell, *whereby we may diſcover the Situation of the Heart at* A.

PLATE XXIV.

Fig. I. *A* Garden Spider.
Fig. II. *The* Long Legs.
Fig. III. *An* Hedge Spider.
Fig. IV. *A* Garden Spider.
Fig. V. *The* Jumper *or* Tick Spider.
Fig. VI. *The* black Houſe Spider, *whoſe* Antennæ *are ſeemingly pointed with* Diamonds.
Fig. VII. *The* Velvet Long-Legged Spider, *taken under the Eaves of a Houſe at* Newington.
Fig. VIII. *A* black Hedge Spider.
Fig. IX. *A* ſtriped Hedge Spider.

N. B. Theſe are the 9 Claſſes of *Engliſh-Spiders* collected by Mr. *Dandridge.*

Fig. X. *The* Tarantula, *or* poiſonous Spaniſh-Spider; *from the Royal Society's* Collection.

CHAP.

C H A P. XII. and XIII.

Of the Papilionaceous *or* Butterfly *Kind*; *and of* Bees, Flies, *and ſome* Others *obſerved with the Microſcope.*

AMONG the ſeveral Species of *Inſects*, we do not find any that poſſeſs a greater Share of Beauty in the Colours of their Clothing, nor a more exact Symmetry in the Arrangement of their Parts, than *Theſe*. To this we may add the ſurpriſing Changes of theſe Creatures, between the Time they are in the *Egg*, and their taking *Wing*. Thoſe of the *Butterfly* Kind are moſt commonly marked with the gayeſt Colours; and the *Moths*, which are regularly marked and variegated, have an agreeable Diſpoſition of the graver Colours: But however theſe are *grave*, or the others *gay* in the Colours they are adorned with, there is ſo juſt a Harmony between one Colour and the other, that we can never ſay the Grave is *dull*, nor the Gay too *glaring*. Both the *Butterfly* and the *Moth* have their *Wings* adorned with *Feathers*, as regularly diſpoſed as thoſe in the *Wings* of *Birds*, though they are hardly to be diſcerned without the Aſſiſtance of *Microſcopes*, and is that which is erroneouſly called the *Duſt* of their *Wings*. The Bodies of the firſt are divided into 3 Parts; the *Head*, joined by a tender *Filament* to the *Center*, or *middle Part* of the Body, and that again is more ſtrongly joined to the *Tail*, which conſiſts of many *Annuli*. The Bodies of the *Butterflies* are long and thin; but thoſe of the *Moth* Kind are thick and ſhort. All of the firſt Race have long ſlender *Antennæ* knotted at the Points; but the *Moths* have their *Antennæ* ſhort and feathered. And we may again make this Diſtinction between theſe *Two*, that the *Butterflies* always fly in the Heat of the Day, and the *Moths* after the Sun is down. I am the rather thus full in the Particulars of theſe Creatures, when they are in the *Winged* State, becauſe it is neceſſary to ſpeak of the Manner of their *Generating* before I treat of their *Eggs*. The Life of theſe Creatures, in this State of Perfection, is much *longer* in the *Butterfly* than in the *Moth* Kind. I have known *Butterflies* live 3 Weeks; but I have never obſerved the *Moth* to live ſo long. The Manner of their *Generating* is equally performed by Coupling; but Mr. *Dandridge* makes this Remark on the Method of *Coupling* in *Inſects*, that the *Female* always enters the Body of the *Male*, contrary to all Creatures of other Kinds, which he ſays is the ſame with the common *Fly*, that we may more eaſily obſerve it. Immediately after the Coupling of theſe Creatures, they lay their *Eggs*, and are ſo obſervant (if they are at Liberty) of the Place they lay them upon, that we may be aſſured it is proper for their Hatching, and convenient for their feeding, when they are in the *Caterpillar*. If we examine their

Eggs with a *Microſcope*, we ſhall find ſome of them *tranſparent*, and others *opaque:* The *tranſparent Eggs* are *ſterile* or *barren*; but the others will hatch at their proper Seaſons, if the Weather be agreeable to them. In the Caſe of *Silk-Worms*, it is held by ſome *Romiſh* Superſtitions, convenient to carry the *Eggs* to Church, upon the Feſtival of a certain Saint, by the Miſtreſs of the Family, who carefully wraps them up in a Cloth, and lays them in her Boſom, till ſhe has performed ſome particular Duty; but it is the Warmth of her Boſom which has ſo much Influence over the *Eggs*, that they hatch at her Return Home.

The *Eggs* of all the *Papilionaceous* Tribe have different Length of Time to hatch in, as their Originals are different in other Reſpects. Some will only lie a few Days, others 2 or 3 Weeks, and others 6 or 8 Months, without hatching: And again, the *Caterpillars* or *Nymphæ* of theſe Creatures have different Periods of Time allotted them for growing to their full Proportion; and their Forms, in their *Nymphal* State, are every one reſpectively agreeable to their ſeveral Tribes, and have ſome of them in that State the Appearance of 8 and 10 *Legs* apiece, altho' they never exceed 6 in Number when they come to have *Wings*. They are frequently variegated with beautiful Colours, and often ſurpriſingly clothed with *Hair*; and yet it is not to be obſerved, that either the *Hair* or *Colours* they poſſeſs, while they are in this

State, is any way agreeable to what we find in them when they have got *Wings:* Nor indeed can we expect to find them ſtrictly the ſame, becauſe, while they are laid up in the *Chryſalis*, every Part of the preceding *Caterpillar* ſeems to be reduced to a State of Confuſion, much more than we can imagine it was even in the *Egg* or unhatch'd State. All theſe, during the Time they are in the *Nymphæ*, feed upon the *Leaves* or *Flowers* of *Plants:* And we find by Experience, that Nature has appointed each particular Kind of *Inſect* to feed only upon a particular ***Plant***; and even the ſame *Inſect* that is appointed to feed upon the *Leaves* of a *Plant*, will not feed upon the *Flower* of the ſame; but the *Flowers* have equally different Kinds of Deſtroyers as the *Leaves* have; and I think ſuch as feed upon the *Bloſſoms* or *Flowers* of *Vegetables*, change commonly into *Moths*; but the *Leaf-Eaters* are for the moſt Part *Butterflies*. Some of theſe, when they change from their *Caterpillar* State into a *Chryſalis*, incloſe themſelves in ſilken Bags: Others make their Retreat under ſome Shelter, or make their Way into the Earth while they are in this State. Their Figures are all different, as were their *Nymphæ*. And as the Time required for the hatching of the *Eggs* of the ſeveral Kinds is as various as themſelves, ſo likewiſe the different Periods of Time neceſſary for the changing them from this ſtupified State to that of the *Fly* are as different; ſome of them only remaining thus for a few Days, others a few Weeks, or ſome Months. What I here take notice of relating to the Food and Manner of breeding of *Inſects*, eſpecially that every diſtinct Kind of *Inſect* has a *Plant* peculiar to itſelf to feed upon, I firſt learned from that excellent Lady the late Dutcheſs of *Beaufort*, whoſe Curioſity and Skill in natural Knowledge gave Life to many Diſcoveries, which, without her happy Influence, would have lain uncultivated and uſeleſs to the World. This Lady had ſeen the Progreſs of many Kinds, and I believe has bred a greater Variety of *Engliſh Inſects*, than were ever rightly obſerved by any one Perſon in *Europe*.

When the *Papilionaceous* Race has got ſo far as to enjoy the Power of Flight, their extraordinary Frame and Colouring will afford us Matter enough for Admiration; eſpecially if we could have an Opportunity of contemplating thoſe ſurprizing Collections of Sir *Hans Sloane*, Mr. *Vincent*, Dr. *Ruyſh*, and Mr. *Seba*, where we may obſerve many *Thouſand* Varieties of Foreign *Inſects*; and alſo in that curious Cabinet of Mr. *Dandridge*, who has ſo induſtriouſly collected the *Inſects* of our own Country: Some of the *Moth* and *Butterfly* Tribe being ſo large as to meaſure 8, 9, and 10 Inches between the extreme Points of their *Wings*, eſpecially thoſe which breed about *Amboyna* in the *Eaſt-Indies*, and might certainly be propagated with us, if we had the proper *Plants* to

feed

ſeed them with, and perhaps might produce ſomething as uſeful as Silk, if we were to enquire into them. But while that Opinion reigns in the World, that we know enough already, and thereby the Search of Novelties is made ridiculous, we muſt be content to let many valuable Things lie undiſcovered, as the *Load-Stone* did for many Ages. How uſeful are ſeveral *Earths*, *Vegetables*, and *Inſects* in Medicine, and in ſome other Caſes already diſcovered; and why may we not hope ſtill to diſcover the hidden Virtues in other *ſuch-like Bodies*. The *Silk-Worm*, at preſent, carries the Day before all others of the *Papilionaceous* Tribe, as it furniſhes the Principles of the gayeſt and richeſt Clothing, although the Creature itſelf has the meaneſt Appearance of any of its Claſs. It is obſerved of this Race, that they ſeldom fly higher than 10 or 12 Yards from the Ground. And we may farther remark, that the *Butterfly* and *Moth* Kinds never keep in Flocks, as ſome other *Inſects* do, although perhaps 500 are hatched together from the *Eggs* of one *Dam*.

Mr. *Dandridge* obſerves, that there are gradual Alterations from a perfect *Moth* to the *Bee* Kind; and indeed, if we examine the 26th Plate, we may find a juſt Progreſſion from one to the other. The *Antennæ* of all are alike, and their Bodies are juſt different enough to be diſtinguiſhed from one another, bearing about the ſame Proportions of Difference that an *Horſe*

Horſe does a *Mule*, or a *Mule* to an *Aſs.* The *Wings* are 4 in each, thoſe of the *Moth* feather'd all over: Next to which is a Degree of *Moth* with tranſparent *Wings*, feathered only about one 4th part; the 3d with *Wings* like the 2d but thinly feathered on the Edges; and laſtly, the *Humble-Bee*, whoſe *Wings* have no *Feathers.* And ſo I doubt not but we might proceed as gradually thro' the *Bees*, *Waſps*, and *Ichneumon* Kinds, to the *Flies*, and ſuch as have only 2 *Wings*,

I come now to ſpeak of *Bees*, from whoſe induſtrious Race we are ſupplied with Food, as the *Silk-Worm* contributes to our Clothing. The Induſtry of the *Bee* has given ſome Authors occaſion to write largely of them; and ſuch as have Glaſs Hives meet daily with ſome new Diſcovery worthy their Contemplation. The Method of building their *Combs* is ſo mathematically diſpoſed, that the Skill of the greateſt Artiſt cannot exceed the Juſtneſs and the Beauty of its Contrivance. The Hexagonal Figure of the Cells which compoſe the *Comb*, ſuch as leaves no Vacancy or Space unemployed, but each reſpective Side of one Cell ſerves equally to make good Part of another, as it is well explained in the *Account* of *Bees*, in the *Hiſtory of the Royal Academy of* Paris *for the Year* 1712. The *Matter*, of which the *Bees* make their *Wax*, is chiefly the *Farina Fæcundans*, or *Duſt* of the *Apices* of *Flowers*, which they gather in ſmall Parcels, and lodge in the Cavities of their *hind Legs*, and even upon the *Hairs* which are diſperſed here and there upon their Bodies; for which Reaſon I ſuppoſe that *Bees-Wax* may contribute greatly to Vegetation. Upon the coming home of one of theſe laden *Bees*, we may obſerve how readily he is diſcharged of his Burden by others of the ſame Colony. I have ſeen about 10 or 12 *Bees* at work, to diſcharge one ſingle *Bee* of the *Wax* he has brought home, and convey it to others which were employ'd in building and framing the Cells; nor is their Labour in gathering the *Honey* from the Bottom of the *Flowers*, nor their Diſcharge of it from their Bodies into the prepared Cells, leſs admirable. The Manner of their Breeding is yet Matter of Diſpute; ſome Authors tells us, the *Queen-Bee*, which is always larger than the reſt, is both *Mother* and *Queen* to the whole Colony; whereas, on the other Hand, the chief *Bee* of a *Hive* is ſtiled the *King*: But however this be, we find by Experience, that where this Governor is wanting, and has by Accident been deſtroyed, the whole *Hive* decays and comes to Ruin. I have with great Pleaſure admired many of their Ceremonies about the Time of their Swarming, eſpecially 3 or 4 Evenings before they are *going out*: The *Queen Bee* appears at the Mouth of the *Hive*, and is guarded at that Time by 4 or 5 Ranks or Files of *Bees*, who ſtand before her in ſtrait Lines, fluttering their *Wings*, and making a Noiſe, without moving from their Place, leaving Room enough between the Ranks for the labouring *Bees* to paſs backwards and forwards. The Time of their Swarming is commonly in *May*, unleſs we have a Degree of Heat before that Seaſon which is equal to the Temper of Air at that Time, as it ſometimes happens in *February* or *March*. A curious Obſerver of *Bees* tells me, that he has known it practiſed, when a Swarm is inclinable to fly away, to fling Duſt among them, or, if they are out of reach, the firing of a Piſtol will make them ſettle immediately; which, I think, carries Reaſon enough along with it, conſidering how much an approaching Storm makes them hurry home to their *Hives*; I ſuppoſe, by preſſing the Air in an extradionary manner, ſuch as the firing of a Gun or Piſtol will do. In ſhort, their Oeconomy, their Battles, Robberies, Manner of Burying their Dead, and deſtroying their Drones, are Particulars ſurpriſingly curious. As to the Make of the Body of a *Bee*, it is divided into 3 Parts, very tenderly joined together; the middle Part ſeems to contain the greateſt of their Strength, and in it ſeems to be the chief Reſidence of the Power of Motion: To it are joined the *Legs*, which are 6 in Number; and the *Wings*, which are always 4 in the *Bee* Race, or ſuch as have Stings like *Bees*. Some of the *Humble-Bees*, which come neareſt in Form to the *Honey Bees*, have Stings; but others more remote from that Figure have none. The *Waſp* and *Hornet* are in moſt Particulars like the *Tame Bee*, and are not without the Skill of compoſing their *Cells* and *Combs* in as artful a manner as thoſe of the *Bee* kind; but their Order and Diſcipline in other Matters do not ſeem ſo regular. All this Race have a Power of walking up ſuch Surfaces as are as ſmooth as a well plained Board.

It is obſervable as well in the *Waſp* as in the *Bee* kind, that if we cut their Bodies to pieces, every Part will retain Life for many Hours, ſuch as I have obſerved in the Fleſh of *Eels* and *Vipers*; which ſems to agree in ſome meaſure with the Life in *Vegetables*, whoſe ſeveral Parts, being ſeparated from one another, will retain their Verdure for a long Time, and even be diſpoſed to grow, if they are managed according to Art. Next to theſe we may place the *Ichneumon Flies*, which have generally 4 *tranſparent Wings*, 6 *Legs*, and the Body divided into 3, and joined by tender Veſſels like the *Bee* Kind: Some of theſe lay their *Eggs* in the *Parenchymous* Part of *Leaves* and *Fruit*; others in the *Nympha* or *Caterpillar* of *Inſects*; every one of them having a proper *Matrix* for the hatching of its own *Eggs*, or *Nidus*, diſtinct to it ſelf, in ſome living Body conſiderably different from itſelf. I obſerve, that ſuch as lay their *Eggs* in the *Leaves* or *Twigs* of *Trees*, do that Work while thoſe Parts of the *Plant* are very tender, which they wound in ſuch a Manner, and ſprinkle with a *Liquor*, which they emit when they lay their *Egg*, as changes the firſt *Vegetative* Intent, and diſpoſes the Parts of the *Leaf* or *Twig* to produce an unconmon Appearance, ſuch as the *Bliſters* upon the *Leaves* of *Oaks*, called *Oak-Berries*, and thoſe *Excre-*

ſcences called *Oak-Apples*, which are occaſioned by theſe *Inſects*, and ſerve as *Neſts* to incloſe, nouriſh, and hatch their *Eggs*. Thoſe of the *Ichneumon* Race, which lay their *Eggs* in the Bodies of *Caterpillars*, have no further Care for the hatching of thoſe *Eggs*; the Body of the *Caterpillar* affording them every Thing neceſſary, as well for their Hatching as their Nouriſhment, till they are fully perfected. Among the *Inſects* I have bred, I have found many of the *Ichneumon* Tribe come out of the *Aureliæ* of the *Butterfly* and *Moth* Kinds, after having devoured all the Moiſture of the Mother *Inſect* which they were hatched in; this has made ſome miſtake the *Aureliæ* of certain Kinds of *Butterflies*, to be the *Aureliæ* of *Ichneumon Flies*.

We next come to conſider the *Beetles*, a Race of *Inſects* whoſe *firſt* Food is, for the moſt part, the *Wood* and *Bark* of *Trees*: Theſe have as many Changes as the former; the Structure of their Bodies in ſome Reſpects agreeing with thoſe of the *Bee* Kind; the Bodies of theſe being divided into 3, but more ſtrongly united together. The *Caſe* of the Bodies in theſe is hard and ſubſtantial; their *Legs* are always 6 in Number, compoſed of a hard *Horney* Subſtance. They have 2 Pair of *Wings*, the uppermoſt very hard and ſtrong, which ſerve for Caſes for the other 2, which are thin and tranſparent, and ſo diſpoſed as to fold up or expand themſelves at the Will of the *Inſect*. Their *Creſt* or *Head* is hard, and commonly ſhining, and in moſt of them as black as

Jett, and of very ſurpriſing Forms; ſome of them having *Pinchers*, like the *Horns* of *Bucks* and *Stags*; others have their *Heads* imitating the *Rhinoceros*; others have *Horns* like *Bulls*, and ſometimes reſembling the *Snout* of an *Elephant*, which makes us diſtinguiſh them by the Names of *Bull-Beetles*, *Stag-Beetles*, &c. They have 2 *Eyes* to ſee with, which demonſtrates the Error of our old Proverb, *As* Blind *as a* Beetle. Their Time of Flight and appearing abroad is in the Evening; and the great Strength of their *Wings* and *Joints* is very remarkable, being able not only to reſiſt a conſiderable Force, but even to ſupport their Bodies in the Air, and carry them ſeveral Yards, with a Weight in their *Pinchers* of about 3 or 4 Ounces, ſuch as a *Wand* of half a Yard long, and about half an Inch diameter, which I have ſeen our *Engliſh Stag-Beetle* fly with ſeveral Yards. The upper *Wings* of theſe Creatures are ſometimes very finely variegated, and ſome of them appear as if they were made of ſolid Gold, ſhining thro' a tranſparent *Green*, *Blue*, or *Red*, Colour. The largeſt *Kind* I have yet ſeen, is the *Bull-Beetle*, whoſe Head and Body meaſures near 4 Inches; one of which Kind is now in the *Muſeum* of the Royal Society. The *Stag-Beetle*, from the *Eaſt Indies*, is likewiſe very large; and the Varieties of this Kind of *Inſect* are generally of ſuch remarkable Forms, that I think them no leſs worthy our Obſervation than the moſt curious animated Bodies. The Cabinets of Dr. *Ruyſh*, Mr.

Seba, Mr. *Vincent*, Sir *Hans Sloane*, &c. are ſtored with theſe Rarities. Among theſe caſed winged Creatures is the *Lady-Cow*, which has likewiſe its Varieties, beautifully ſpotted with the gayeſt Colours; and what gives me more than ordinary Satisfaction in contemplating this Kind of *Inſect*, is, becauſe there is good Reaſon to believe the *Cochineel* is of the ſame Tribe. That learned Apothecary, Mr. *Petiver*, has often told me, that in ſeveral Parcels of the *Cochineel*, he has found a Kind of *Lady Cow winged* and *perfect*, which he ſuppoſed was the *Cochineel Inſect* in its mature State. And Monſieur *Lewenhoeck*'s Obſervations, in *Phil. Tranſ.* No. 292, gives me a farther Confirmation, that the *Cochineel* is an *Inſect*; and upon the Foot of his Obſervations I have more than once made uſe of my *Microſcopes*, to examine the Form and Structure of this valuable Creature, by which I was confirmed in many Things related by Monſieur *Lewenhoeck*, to whoſe Account I refer my Reader; but cannot help obſerving, that about 1718 I had a Preſent made me of ſome *Cochineel* which grew in *Carolina*, and was found upon the *Prickly Pear*, or *Indian Figg*, growing in that Country, by a Slave, who had once been employed by the *Spaniards* in catching and ordering *Cochineel* in their *American* Settlements; and I doubt not but it might be found in many other Parts of *America*, if we knew how to look for it. By what I could learn from the

Gentleman who brought it over, and had ſeen it grow, the *Inſect* is not winged when they take it for Uſe, but rather in its third State, or laid up in its *Chryſalis*. He told me that ſome *hundreds* of them were found together in a Kind of *Silken Web*, which I ſuppoſe was of their own ſpinning, and ſeems to determine that they could be then in no other State but in the *Chryſalis*, and by the *Microſcope* have an Appearance not unlike the *Chryſalis* of our common *Lady-Cow*. It was found upon Trial, that the *Cochineel* from *Carolina* was in every Reſpect as good as that brought from the *Spaniſh Weſt-Indies*. For the better Satisfaction of my Reader, I have given him a Cut of the ſeveral Stages of our common *Lady-Bird*.

The next Tribe of *Inſects* which I ſhall take notice of, is the *Locuſt*, or *Graſshopper* Kind, whoſe Race is as numerous as any I have yet mentioned, as may be obſerved in the abovenamed curious Cabinets, eſpecially in that of Mr. *Vincent*. Their *Caſe Wings* are not ſo ſubſtantial as thoſe of the former, but are as beautifully adorned. They have all 6 *Legs* a-piece; the two *hinder Legs* chiefly diſpoſed for Leaping, or raiſing their Bodies, till they can take *Wing*; but I can give no certain Account either of their Manner of *Generating*, or how they are *brought forth*, or proceed to their *winged* State. The Bodies of ſome of theſe are about 3 Inches long; and ſome Sorts that I have ſeen in Dr. *Ruyſh*'s Cabinet, meaſure 7 or 8 Inches.

It is obſervable, that this Race of Creatures have a Chirping Note or Voice, which is not remarkable in any other *Inſect*, but the *Pediculus Pulſatorius*, or *Death-Watch*: For though other *Inſects* make a humming Noiſe, I ſuppoſe that to proceed from the quick beating of the Air with their *Wings*, ſuch as may be produced by whirling about a Bit of Stick at the End of a String. And although the *Maſter Bee* of a *Hive* is diſtinguiſhed from the reſt, by its different humming Tone, the ſuperior Size of its *Wings* may as well make his Sound different from the reſt, as the larger *Pipes* of his *Throat* (were they to be made uſe of as *Organs* of Sound) would produce a Note different from the ſmaller *Pipes* of the others, which are about one third leſs.

Next to theſe I place the *Libellæ*, or *Pond-Flies*, or, as ſome call them, *May-Flies*, or *Cadew-Flies*. The Bodies of theſe Creatures are divided into 3 Parts, as the *Inſect* treated of before; and the *Tail* Part of them is like the reſt, compoſed of jointed *Annuli*. To the central Part of their Body are joined their 6 *Legs*, and 2 Pair of *Wings*, curiouſly wrought, and of a Texture like fine *Gauze*: Their *Eyes*, which employ the greateſt Part of their *Head*, appear like Glaſs: The Colours of their Bodies are for the moſt Part tending to *Green*, *Blue*, or *Yellow*; and I have not obſerved above 2 Kinds of them which have had any *Red* about them. Mr. *Dandridge*, and the late curious

Mr. *Petiver*, have both told me, that theſe *Flies* proceed from the *Cados-Worms*; but yet I have not been able to trace any one of theſe *Flies* to its original *Worm*. Nor can I be certain, whether the *Worms*, when they are caſed over, as I have mentioned in my Chapter of *Fiſh*, are then in their *Chryſalis*, or feeding State.

We come now to mention thoſe *Inſects* which are always Inhabitants of the Waters, as well in their *Nymphæ* as in their perfect State, ſuch as the *Water Scorpion*, *Cantharis*, *Water Beetles* of ſeveral Kinds, *Boat-Flies*, a *Monoculus*, and *Cramp Spider*, beſides ſeveral others of ſurpriſing Modes and Forms, which may be obſerved by the Curious. The *Cantharis Aquatica* has but 4 *Legs* regularly ſet on to his Body, and the ſame Number of *Wings*, 2 of them *Caſe Wings*, and the others *thin* and *tranſparent*, which Mr. *Dandridge* tells me they have the Power of uſing even under the Water. The *Beetle* and *Water-Scorpion* are little various in the outward Structure of their Bodies, and have ſix *Legs* like the *Beetle* Kind upon the Land. But the *Boat-Flies* are very different from all other Kinds of *Inſects*, having their *Legs*, which are very long, placed about the Middle of their Bodies; which ſerve as Oars to row them from Place to Place. The Shape of their Body is ſo like a common *Wherry*, that it gave them the Name of *Boat-Flies*. It is obſervable, that this *Inſect* always ſwims upon its Back. Dr. *Deſaguliers* once ſhewed me many of this Tribe in a Drop of Water, wherein *Leather* had been ſteeped, which were ſo ſmall, that the double *Microſcope* did not make them appear half an Inch long; and I ſuſpect that they are *Inſects* only in their *Nymphal* State. At the ſame Time the *Doctor*, in Preſence of ſeveral Gentlemen, firſt gave me the Pleaſure of obſerving a wonderful *Inſect* which he had found in *Thames* Water, which had but one *Eye*, or perhaps one Globe of *Eyes*, placed in the Middle of its *Forehead*. This Creature may be very eaſily obſerved in the Month of *July*, which is the common Time of its appearing in great Numbers. Its natural Size is about the Bigneſs of a *Flea*, which obliged us to have Recourſe to the *Microſcope*, for the better viewing its Parts; we then obſerved that the *Head* was ſomewhat like that of a *Bird*, firmly joined to the Body, which was of an *Oval* Figure, ending in a pointed *Tail*. The Parts which ſeem to do the Office of *Legs*, and fling this Creature forward in the Water by regular Springs or Jirks, are almoſt like the *Claws* of an *Eagle*, and are 2 in Number, placed on each Side of its Belly: On the Fore-part of its Body, near the Head, are placed 2 *Branches*, reſembling the *Dugs* of *Animals*, from which proceed ſeveral capillary *Spines*; theſe I did not obſerve had any Motion; and if one may judge of them by their Appearance, we might ſuppoſe them deſigned for ſuckling their Young; for this *Inſect* is *Viviparous*, which is contrary to other *Inſects* before mentioned; for we did not only obſerve the young ones alive in the Belly of the Mother, but likewiſe ſaw ſeveral of them excluded from her Body. This curious *Inſect* I delineated with all poſſible Exactneſs, with the Aſſiſtance of Dr. *Deſaguliers*, and the Gentlemen then preſent.

The *Gnat* Kind next follows the *Water-Inſects*, as they live the greateſt Part of their Time in the Waters: Their Bodies, when they are in the *winged* State, are divided like thoſe of the *Libellæ*; they have ſix Legs a-piece, though the Number of their *Wings* is not always conſtant: Some Kinds have 4 a-piece, and the others but 2; but they are all *tranſparent*, and their Texture much like that of the *Waſp*, or *Bee* Kind. This Difference in the Number of *Wings* is ſomewhat like that which we obſerve between the *Bee* and *Fly* Kind; and perhaps we might obſerve other as remarkable Differences as we do between the *Flies* and *Bees:* The 4 *winged* Kinds having, it may be, Stings, or ſome venomous Quality in them, and the others harmleſs as *Flies*. The Reverend Mr. *Derham* has obſerved above 30 ſeveral Kinds; and has remarked the *Male* and *Female* either *in Coitu*, or has diſtinguiſhed them by their *Antennæ*, or their Bellies, which are always larger in the *Females*, though unimpregnated, than in the *Males*. This curious Gentleman has given us a large Account of the Manner of the *Generation* of *Gnats*, in his excellent *Phyſico Theology*, where he tells us, " That the *Culices* " *Maximi*, or the largeſt Sort of *Gnats*, lay " their *Eggs* in *Meadows* under the *Graſs*; and " there is one of the middle Sort which lays its " *Eggs* in dead Beer *Yeaſt*, &c. but all the " reſt, which he had obſerved, lay and " hatch in the Waters. The *Gnat*, which " he mentions to lay its *Eggs* in dead Beer, " hatches ſome time after into *Maggots*, which " are ſo numerous, that the whole *Liquor* ſtir- " reth as if it were alive, in which were obſerv- " able, ſome that were larger, others ſmaller; " the larger are the Offspring of our *Gnat*; the " others of a ſmall dark coloured *Fly*, tending " to reddiſh, frequent in Cellars, and ſuch ob- " ſcure Places. All theſe *Maggots* turn to " *Aureliæ*; the larger of which, of a *Tan* " Colour, turn to our *Gnat*, which is of the " unarmed Kind, having no Spear in its " *Mouth*; its *Head* is larger than what is ob- " ſerved in the common *Gnats*, a longer " *Neck*, ſhort jointed *Antennæ*, ſpotted *Wings*, " reaching beyond its ſlender *Alvus*; it is " throughout of a *brown* Colour, tending to " *red*, eſpecially in the *Female*. The chief " Difference between the *Male* and *Female*, is, " as in other *Gnats*, (yea, moſt *Inſects*) the " *Male* is leſs than the *Female*, and hath a ſlen- " derer Belly, and its *Podex* not ſo ſharp as the " *Female* is.

That curious Gentleman obſerves, " that " ſuch of the *Gnat* Kind as are of the Water " Race, lay their *Spawn* (ſome of them) above " an Inch long, and half a Quarter Diameter, " which floats in the Water. When theſe *Eggs* " are, by the Warmth of the Seaſon, hatched " into ſmall *Maggots*, they deſcend to " the Bottom, where they make themſelves " little Caſes, which they creep into and out " of at Pleaſure, until they are arrived unto a " more mature *Nymphal* State, and can ſwim " about to ſeek their Food; they are then a " Kind of *red Worm*, above half an Inch long; " it then enters its *Aurelia* State, and from " thence proceeds to its mature State, all as " different as to Shape and Accoutrements, as " if the *Inſect* was three different *Animals*. In " its firſt or *Vermicular* State, it hath a Worm-" like Body, and ſwims about by Curvations, " appearing like the Figure of an S; but in its " *Aurelia* State it hath a quite different Bo-" dy, with a *Club-Head*, (in which the " *Head*, *Thorax*, and *Wings* of the *Gnat* are " incloſed) a ſlender *Alvus*, and a finny *Tail* " ſtanding at right *Angles*, with the Body " quite contrary to what it was before; by " which Means, inſtead of eaſy flapping ſide-" ways, it ſwims by rapid brisk Jirks the quite " contrary Way; but when it becomes a *Gnat*, " no finny *Tail*, no *Club-Head*, but all is made " in the moſt accurate Manner for Flight and " Motion in the Air, as before it was for the " Waters."

This Account, as I am ſatisfied it is exact in moſt of the Particulars, may lead my Reader into a right Method of obſerving the others, and perhaps give him an Opportunity of diſcovering other ſurpriſing *Phænomena* in this wonderful Creature. It is ſome of the *Gnat*-Kind, in their *Nymphal* State, which has oft-times given occaſion to ignorant People to ſuppoſe that ſome Waters were turned to Blood; for I have ſeen Ponds and Ditches, about *Midſummer*, whoſe Waters appeared of a red Colour, having all their Bottoms cover'd with theſe Creatures in their *Vermicular* State, which diſappear for ſome Yards Space upon touching only one or two of them, but creep out again of their *Cells* or *Caſes* in a Minute or two, and reflect their *red* Colour in the Waters: Their Life is very ſhort in their perfect State, their chief Buſineſs then being only *Generation.* I obſerve likewiſe, that the Time between the hatching of the *Egg*, and their taking *Wing*, is conſtant; which may be one Reaſon why we obſerve them hovering in Groups over or near the Waters, till they again return to lay their *Spawn.* Some of this Kind, as well as the *Cramp Spider*, are able to walk or ſtand upon the Waters. I have met with a Kind of *Gnat* that had but 4 Legs, whoſe Motion was performed in the ſame Manner of that of *Quadrupedes.* The Wings of theſe Creatures, and almoſt every other *Inſect*, explain and expand themſelves in a few Minutes, after they are ex-

excluded from the *Chryſalis*; and are not fully grown or explained, as ſome have thought, at the Inſtant the *Inſect* quits the *Chryſalis*. I have obſerv'd with Abundance of Pleaſure, at the firſt Appearance of the *Moth* or *Fly*, that their Wings were only beginning to bud; but have unfolded and explained themſelves to their full State or Bounds of Growth, ſome in leſs than 2 Minutes, and others in 3 at moſt, which is a kind of *Vegetation* more ſpeedy than has yet been mentioned; and I the rather chuſe to call it ſo, becauſe we cannot diſcern that the Wings of theſe Creatures have any Share of *Senſation*, eſpecially ſuch as are tranſparent; and their Method of joining to the Body of the *Inſect*, is ſomewhat like the rooting of *Plants* in the Earth; they receive their Nouriſhment from the Body of the *Inſect*, by thoſe capillary *Tubes* which make the Junction between the Wing and the *Inſect*. And if we conſider farther, that the opening and explaining of the Wings of a *Moth* or *Butterfly*, is performed in about 3 Minutes; and that upon the ſame Wings there appears, almoſt in the very Inſtant of Time, a regular Plumage or Feathering, we muſt ſuppoſe the Time of the Growth of ſuch *Feathers* muſt be almoſt inſtantaneous. I have obſerved ſome of the ſmaller Kind of *Gnats*, which have not lived above 8 Hours after they took Wing, having taken them juſt when they were excluded from the *Chryſalis*, and kept them under a Canvas Caſe. This Share of Life does not much exceed the Life of the *Ephemeron*, which is ſaid to live but 5 Hours; but we muſt at the ſame Time take notice, that both the *Gnat* Kind and the *Ephemeron* have a Share of Life much longer under the Waters, altho' under different Forms. We may ſee the Account of the *Ephemeron*, with its *Natural Hiſtory* and *Anatomy*, tranſlated by Dr. *Tyſon* from the Original of Dr. *Swammerdam*.

I now come to conſider thoſe *Inſects* which are of the *Fly* Kind, agreeing partly in Figure, and ſome other Reſpects, with the *Bee* Race. All of the *Fly* Kind have but 2 *Wings* a-piece, and are without Stings; they make no Proviſion for Winter, as *Bees* do; nor do they ſeem to have any Order or Oeconomy among them. Their *Generation* is performed by Coupling; they lay *Eggs*, which hatch into *Maggots*, that afterwards lay themſelves up in *Aureliæ*, and from thence change into *Flies*. The proper *Nidus* for their *Egg* is commonly Fleſh of all Sorts, Dung of *Animals*, and whatever yields a Scent like *Carrion* entices them to it; and it is therefore they are ſo apt to ſwarm about the *Flowers* of the *Frittilaria Craſſa*, that ſtinks like putrified Fleſh, which is the Food for the *Maggots* of moſt *Flies* to feed upon. But it is obſervable, that all *Inſects* are thus carefully led by Nature, to lay their *Eggs* in ſuch Places, where their young ones may find convenient Food. There is indeed one Sort of *Fly* taken notice of by Mr. *Dandridge*, which tho' the

Shape of its Body and Parts ſeem to agree very much with the common *Fly*, yet the Method of breeding its Young is very different. Theſe *Flies* aſſemble together, and hang to one another in ſo great a Number, as to make a Lump or Ball of about 3 Inches Diameter: The Place of heir Meeting is always upon ſome *Twig* over the Water, about *July* or *Auguſt*; while they are in that State, their Young-ones drop from them live into the Water, after they have devoured ll the Moiſture in the Bodies of the Mother *Flies*. This *Fly* is of a Greyiſh Colour, and is he firſt of this Figure that I have heard of which s *Viviparous*, or that has its firſt Stage of Life in the Waters. Mr *Dandridge* has now a large *Bunch* of them in his Cabinet. From the ſame urious Gentleman I likewiſe received the ſurpriſing Account of the *Male* and *Female Glow-Worm*, which I delineated from thoſe in his Collection, taken, *in Coitu*, by the Reverend Mr. *Maningham*, in which Creature the *Phoſphoros* or glimmering Light they afford in dark Nights is not more remarkable, than the Difference of Frame and Parts between the *Male* and *Female*. The *Female* is flat and jointed, and is hat which we commonly obſerve in the *Graſs* and *Hedges*; but the *Male* has *Caſe-Wings*, and many Parts agreeing with the *Beetle*-Race; but whether it could produce a Light like that of he *Female*, I did not learn. The *Male* of this *Inſect* having *Wings*, leads me to gueſs, that uch of the *Piſmires* as have *Wings* are *Males*,

and

and perhaps leave the *Females* after they hav made them pregnant, as the *Male-Bees* or *Dron* are ſaid to do. In *Surinam*, and ſome othe Parts of the *Weſt-Indies*, there is a large *Fl* which they commonly call the *Lanthorn-Fl* that is ſaid to yield a conſiderable Light. W have a good Cut of it in Madam *Marian* *Hiſtory of Surinam Inſects*, and the *Inſect* it ſe is common enough in the *Amſterdam* Cabinet and I think likewiſe in Sir *Hans Sloane*'s *Collection of Rarities*; but I do not yet find any rational Account of the Production of theſe Light any more than of that produced by rotten Woo

The *Ignis Fatuus*, or *Jack in the Lanthorn* I ſuppoſe to be no more than a Group of ſma enlightened *Inſects*, rather than ſuppoſe it an inflamable Vapour, as ſome have taken it to be for if it conſiſted of ſuch *Effluvia* or *Corpuſcula* as riſe from the Earth or Waters that were inflamable, and by ſome Cauſe or other had take Fire, they could not be of ſuch Duration. Beſides, we might as reaſonably expect, that al the *Effluvia* ariſing at the ſame Time from th ſame Body of Water ſhould equally be inflamable as theſe, and ſo the whole Surface of th *Pond*, *Lake*, or *River*, appear all in a Flam at one Time. The ſudden Motion of this Ligh from Place to Place, very much agrees wit the Motion obſervable in the Groups of *Gnats* which move in a Body ſometimes very ſlowly and at other Times drive together with grea Swiftneſs. Happening to diſcourſe upon thi with the ingenious Mr. *Godfrey* the *Chymiſt*, he told me, that he had often obſerved this enlightened Body in ſome Places Abroad, and had caught ſome of the *Inſects* which helped to compoſe it. But allowing it to be as I ſay, the Occaſion of the Light in ſuch *Inſects* remains yet to be diſcovered.

But this ſtrange Light has not given the Vulgar a greater Surprize than the *ticking Noiſe* which is commonly called a *Death-Watch*; and therefore I think myſelf obliged particularly to take notice of it, and ſatisfy thoſe who are yet ignorant, that it is an *Inſect*. The learned Dr. *Derham*, in a Letter to me, mentions 2 Sorts of the *Death-watch*; one is about the Bigneſs and Shape of a *Louſe*, and the other a very ſmall *Inſect* made like a *Beetle*: Theſe commonly are found in *July*, in duſty Places, where they are bred and feed. This curious Gentleman obſerves farther, that they *tick* only when they are about to *generate*; he gives us a Cut of the firſt Kind in its natural Size, and which with the *Microſcope* I have copied from him; but the other Sort I have not been lucky enough to find, though there are many of them (as I am informed) in the great Library at the Royal Society. See more of this Creature, in *Phil. Tranſ.* No. 291.

The next Kind of *Inſect* I ſhall take notice of, is of that Race which is called *Folium Ambulans*, or *walking Leaf*, which I have already treated of in my *New Improvements* of *Planting* and *Gardening:* It is a Creature, which, if we take the Story of it right, partakes both of *Inſectal* and *Vegetative* Life, being nouriſhed, as I have obſerved, as well by the Juices of the *Tree*, which the Mother *Inſect* lays its *Eggs* in, as by its own, which I ſuppoſe are ſo united, that one and the other circulate equally in the Body of the *Inſect*, till itſelf, with the *Leaves* joining to it, drop from the *Tree*, and creep upon the Ground. I have therein given Figures of 2 Kinds of this Creature, which are *Eaſt-Indians*, and have referred to the Cabinets of Dr. *Ruyſh*, and Mr. *Vincent* of *Holland*.

The *Inſects* we come now to take notice of, are of the ſmaller Kinds, *i. e.* thoſe in *Cheeſe*, *ſour Liquors*, *Pepper-water*, *putrified Paſte*, &c. The largeſt of theſe is the *Cheeſe-Mite*, which is however not big enough to have its Parts diſtinguiſhed by the natural *Eye*, but muſt be obſerved with a magnifying *Glaſs* to deſcribe its Appearance. We may remark, by the Help of *Glaſſes*, that this Creature, however *minute*, has all its Parts regularly framed, and its Motion agreeable to larger *Inſects*, with 6 *Legs*. We may likewiſe be aſſured of its *Generation*, like other *Inſects*, by the *great* Numbers a *few* will produce in a little Time, and every one of them of the ſame regular Figure. In *putrified Paſte*, we may obſerve, by our *naked Eye*, a *Motion*, though we cannot diſcern diſtinctly what Bodies they are that move; but if we put the Quantity of a Grain of Sand or that moving *Paſte* into the *Microſcope*, and add to it as much Water, the *fourth Glaſs* of a good *Microſcope* will ſhew them to be *Inſects* of an *Eel*-like Figure, about an Inch long. In the *Lees* of *Wine*, and upon the Outſides of *Wine-Caſks*, we find great Varieties of living Creatures, which are very proper Subjects for the *Microſcope*; and even the *Moſſes* or *Mouldineſs* found in ſuch damp Places as Cellars, and eſpecially where *Wine* is kept, gives us very entertaining Proſpects. *Vinegar* and *Pepper-water* likewiſe afford us Abundance of Variety; but becauſe I have found it a little difficult to bring *Water* and *Pepper* into a right State of yielding theſe *Inſects*, I ſhall take this Occaſion to acquaint my Reader how I brought it to the Perfection I deſired; for I do not know any Author who has yet given the Receipt. In *June* I took a Pint of clear *Water*, and put to it 5 or 6 whole *Pepper-Corns*, which I expoſed in a Porringer to the open Air about 3 Weeks: I then found great Numbers of little *Animalcula* ſwimming in a ſmall Drop of it; but in ſome *Waters*, where I had put beaten *Pepper*, I could not diſcover any *Inſects*. We may farther remark, that if we put *Hair*, *Leather*, or any Part of *Animal* Bodies into *Water*, and let it ſtand for 3 Weeks or a Month, in *June*, *July*, or *Auguſt*, we find it filled with *Inſects* of various Forms; but I ſuppoſe the ſeveral Kinds, obſervable in the ſeveral *Waters*, have not their Original in thoſe Waters, but are ſeverally produced from *Eggs* laid there by ſome *Mother Inſects*, that are then in the Air, which reſpectively come to each of them, as to proper *Neſts* or *Nurſeries* for their Young ; and I the rather am of this Opinion, becauſe if we can keep ſuch Bodies as uſually produce *Inſects* confined by Coverings of *Lawn*, or *Muſlin*, we find no living Creatures in them. And again, as the *Mother Inſects* are of ſuch a diminutive Size, that they are not to be diſcerned without *Microſcopes*, it is no wonder they can lay their *Eggs* in thoſe Mixtures without being perceived ; and I ſuppoſe the Air is full of them, eſpecially in the Summer Months, the ſmaller Sorts ſerving as Food to the larger ; and it may be therefore, that Nature has made the ſmalleſt Kinds more prolifick than the reſt.

I ſhall conclude with ſome Account of the *Animalcula* in *Semine Maſculino*, or of ſuch minute Creatures as are found in the *Male Liquor* of living Bodies, which ſome of the Learned ſuppoſe to be the Rudiment or Principle of the *Fœtus*. In taking this *Liquor* from the ſeveral Kinds of *Animals*, we find by the *Microſcope*, that ſuch *Animalcula* are of different Figures and Bigneſs, as the *Animals* they were taken from differ in their Parts from one another. And theſe minute Creatures have ſo much Life and Spirit in them, that ſometimes they remain alive above 3 Weeks after they are taken from their Parent *Animal*: The different Opinions concerning their Progreſs into the *Matrix* of

Plate XXVI

Fig. I

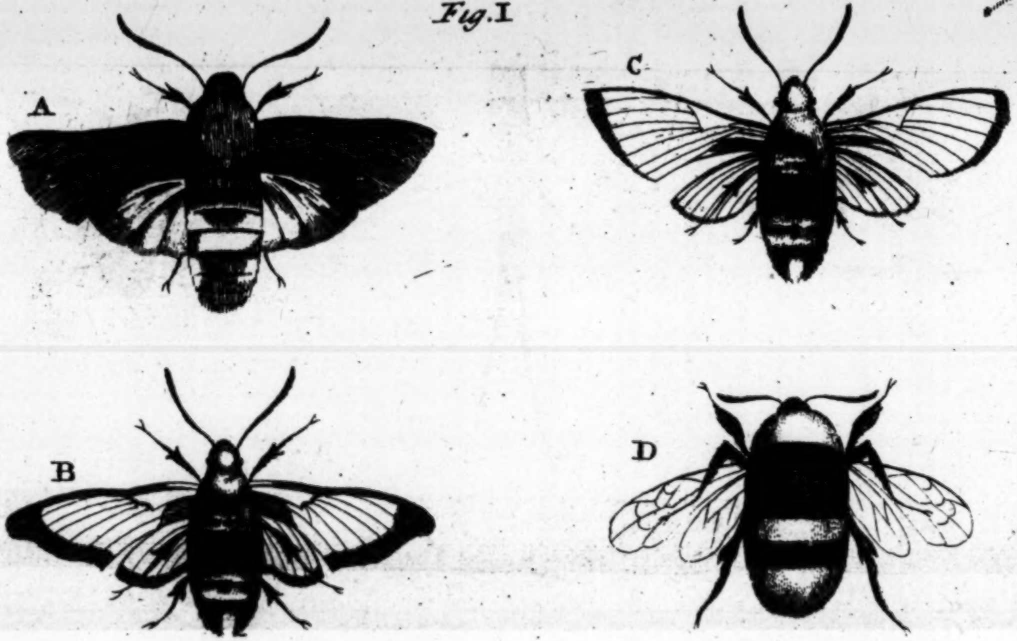


Fig. II

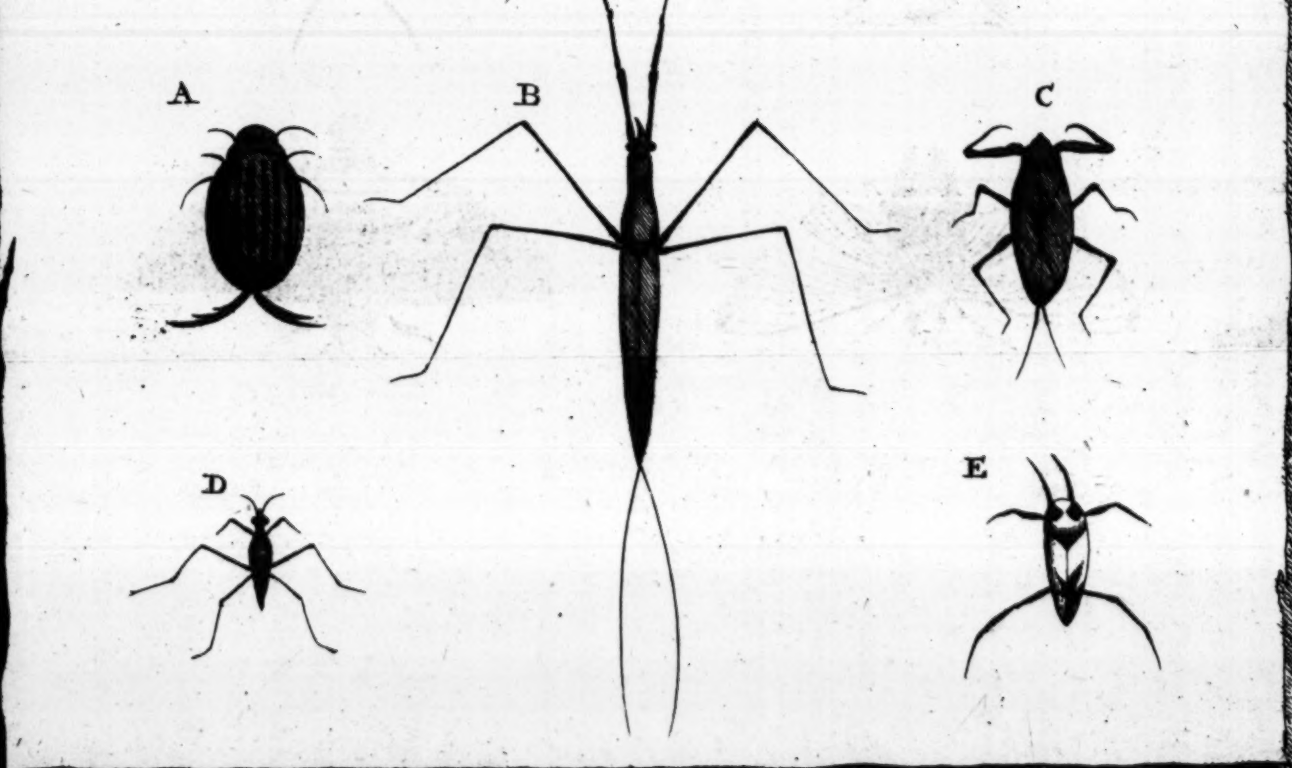


Fig. III

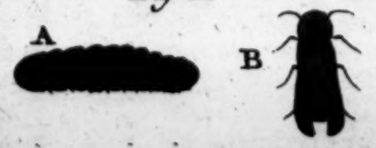


Fig. IV

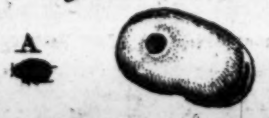


Plate XXV

FIG. I.

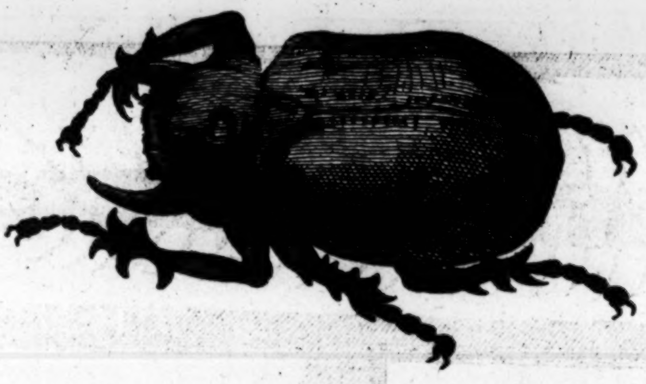


FIG. II.

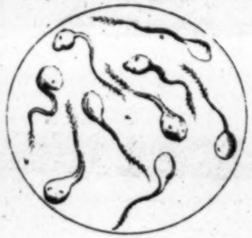
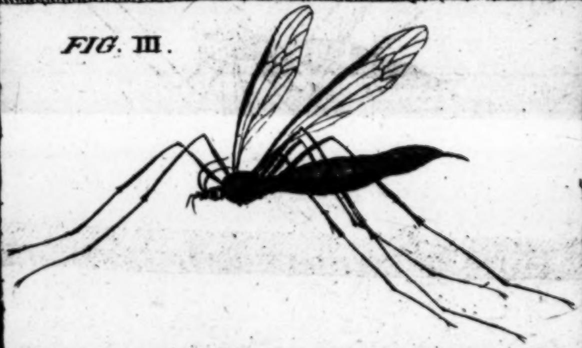


FIG. III.



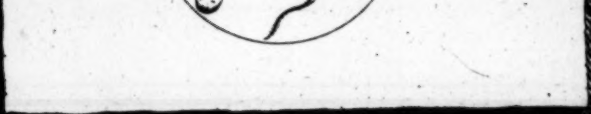


FIG. IV.

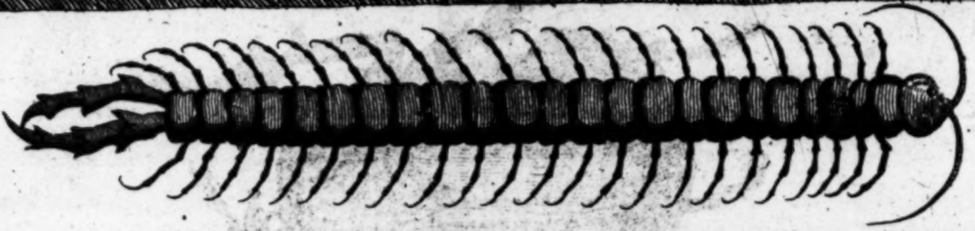
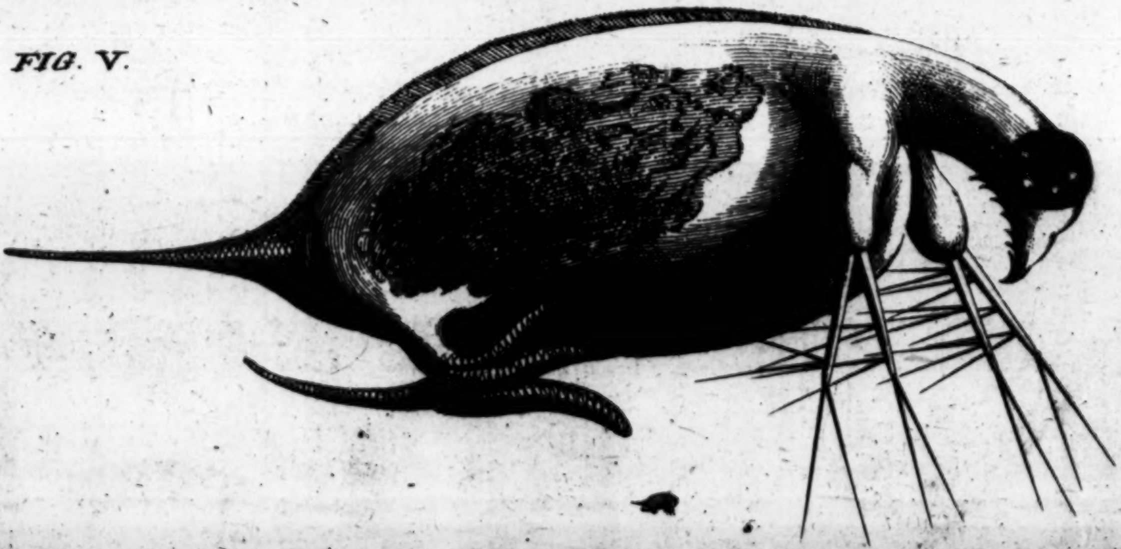


FIG. V.



of the *Female*, I have before given in the Chapter of *Quadrupedes*; the Figures of one Kind of them is delineated below, *viz.*

Explanation of the Plates relating to Chap. XII. *and* XIII.

PLATE XXV.

Fig. I. *The* Bull-Beetle; *from the Royal Society.*

Fig. II. *The* Animalcula *in* Semine Maſculino.

Fig. III. *The* laſt *State of the large* Gnat.

Fig. IV. *A* Centipes; *from the* Weſt-Indies.

Fig. V. *A* Monoculus *found in* Thames *Water*, *by the* Microſcope.

PLATE XXVI.

Fig. I. *Shewing the Gradation from the* Moth A, *by* B. and C, *to the* Humble Bee D.

Fig, 2. A: *A* Water-Beetle.
B: Cantharis Aquatica.
C: *A* Water-Scorpion.
D: Cramp Spider.
E: Boat-Fly.
Fig. III. A: *A* Female Glow-Worm.
B: *The* Male Glow-Worm.

All theſe are from Mr. *Dandridge*'s Collection.

Fig. IV. *The* Inſect *which blighted the* Horſe-beans *in many Parts of* England, Anno 1719, *from the Reverend Mr.* Laurence.

PLATE XXVII.

Fig. I. A: *The* Eggs *of the* Silk-Worm.
B: *The* Nympha, *or* Caterpillar *of the ſame.*
C: *The* Silk-Bag *of the ſame, in which it changes into the* Chryſalis D.
E: *The* Male-Moth *proceeding from the* Chryſalis D.
F: *the* Female-Moth *proceeding from the ſame.*

Fig. II. A: *The* Nympha, *or* Caterpillar, *feeding upon the* Nettle, *which changes to the* Chryſalis B, *to the* Butterfly C.

Fig. III. A: *The* Death-Watch, *of its natural Bigneſs.* B: *The ſame with the* Microſcope; *from the Reverend Dr.* Derham.

Fig. IV. A: *The* Nympha *of the* Lady-Cow. B: *The* Chryſalis *of the ſame: and* C: *The moſt* perfect *State.*

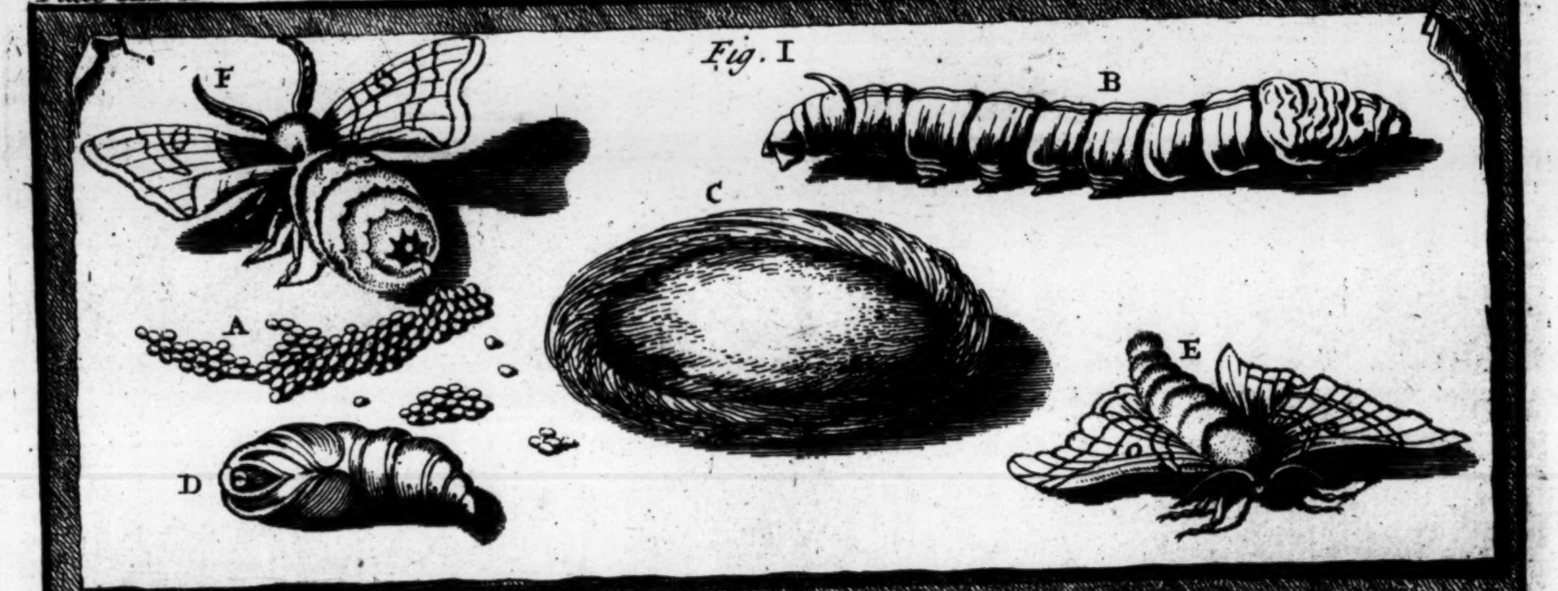
Fig. V. *A* Prega Deos; *from the* Eaſt-Indies.

Fig. VI. *An* Inſect, *from* Amboyna, *whoſe natural Length is eight Inches; taken from the Cabinet of Dr.* Ruyſh *at* Amſterdam.

CHAP.

Plate XXVII

Fig. I



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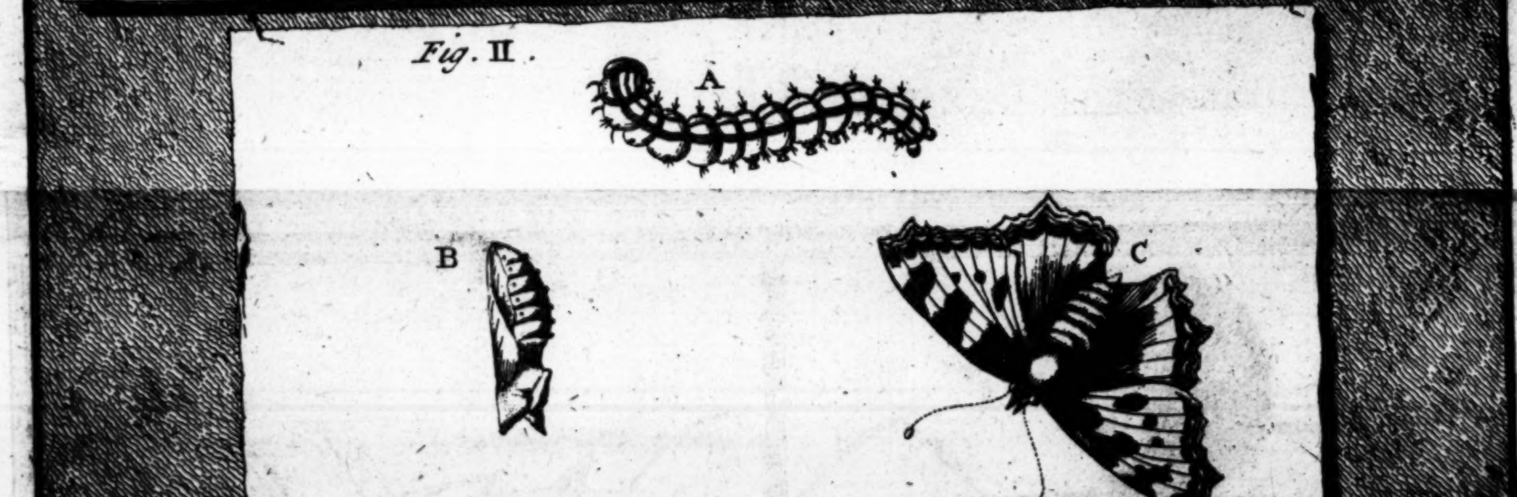


Fig. III

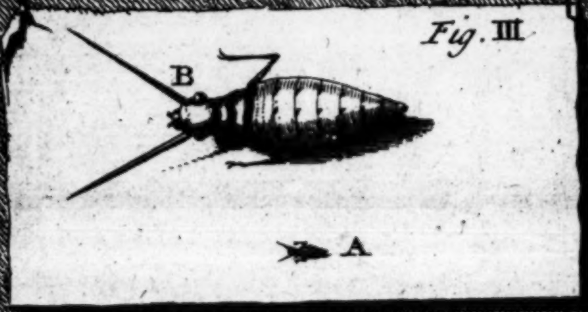


Fig. IV

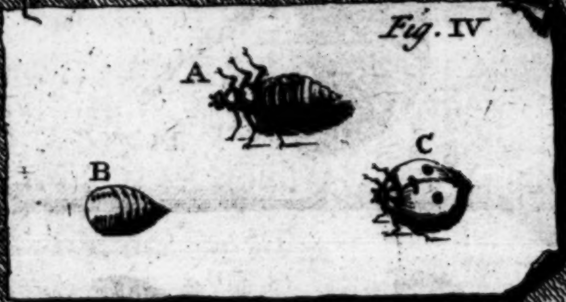


Fig. V

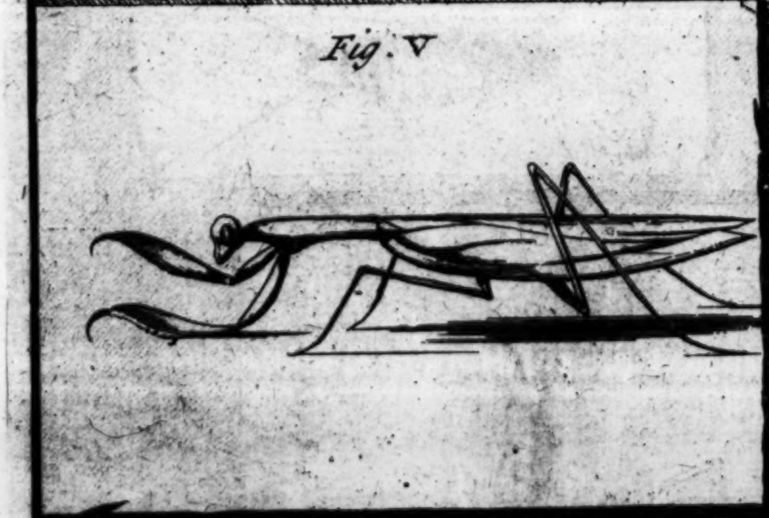
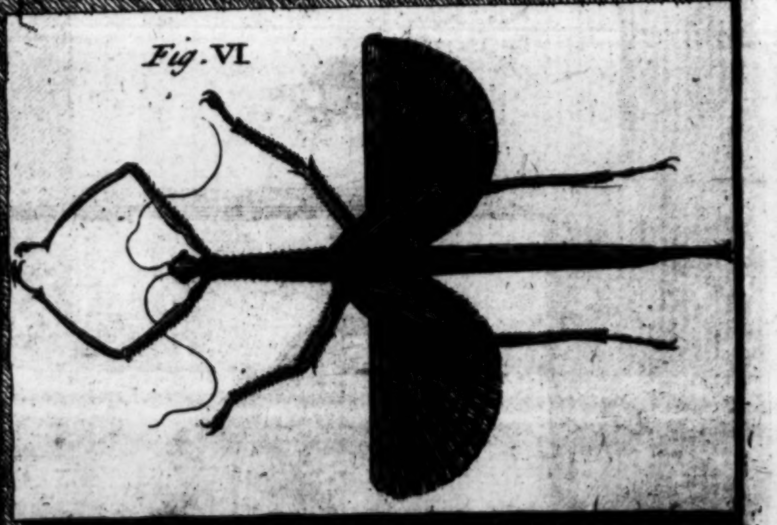


Fig. VI



J. Cole Sculp.

CHAP. XIV.

Explaining the Uſe of the foregoing Remarks, with ſeveral Obſervations relating to CLIMATES.

IN the preceding Chapters I have given a general View of many *Remarkables* in the *Works* of the *Creation*, and have diſpoſed them in ſuch a Manner, as may lead us to imagine, that *all* Bodies have ſome Dependance upon *one another*; and that every *diſtinct Part* of *Nature's Works* is neceſſary for the Support of the *Reſt*; and that if any *one* was wanting, all the *Reſt* muſt conſtantly be *out of Order*. It ſeems in this Caſe, as in that of Numerical Figures, each of which has a Power in itſelf of filling a certain Space, without which the ſeveral Gradations in Numbers cannot be expreſſed; and was there to be wanting any one of thoſe Figures or Powers, the Reſt could not maintain a gradual Progreſſion of Numbers, but muſt frequently make ſuch Breaks and Chaſms as would run them into the greateſt Confuſion and Diſproportion.

We obſerve ſo exact an Harmony between Natural and Mathematical Proportions, as might give every thinking Man Reaſon to believe the Latter could not have been without the Former; or that the Laws or Rules of Mathematics, as they now are, could not be juſt, if Nature's Laws were different from what we now obſerve them to be. In whatever falls under our Obſervation in Nature's Works, we may remark a conſtant Regularity, and a juſt Symmetry and Proportion; the *Vegetables* have their *Roots* proportionable to the *Branches* and *Parts* they are to maintain; the *Animals* have their *Stomachs* agreeable to the Quantity of Food neceſſary for their Support; and even thoſe *Inſects* which are of the leaſt Regard, have every Part diſpoſed with ſuch a juſt Regularity and Propriety, as to bear an Analogy with thoſe in *Animals* of the greateſt Eſteem. The Frame and Figure of the Parts relating to every *Animal*, bears a right Proportion with the Body it is to move or direct: And the Length of Life in all Bodies is more or leſs, as any of thoſe Bodies are later or ſooner coming to their Perfection of Growth; for we obſerve, that ſuch Bodies as are moſt ſpeedy in their Growth, are proportionably ſhort-lived, and of ſmall Remain; and ſo on the contrary. In Muſic, there are 7 diſtinct *Tones* or *Notes*, which ſingly expreſs a Power of *Sound* different from the Reſt; and when any one of thoſe *Tones* is laid down as a Ground-work, the progreſſive *Tones* from that *Ground-Note* to the *Octave*, which is the Reſolve of the *Ground-Note*, declares the *Key*, either by a certain Number of *Semi-tones*, to expreſs Melancholy, in what is called a *Flat-Key*; or by a greater Number of *whole Tones*, to make the Expreſſion more briſk or poignant to the Ear, and then is called a *Sharp-Key*; but whether the *Key* be *flat* or *ſharp*, there is yet a regular Circulation of *Sound*, which is natural to the Ear, and may well enough be compared with the Circulation of Blood in the Bodies of 2 *Animals* of different Species, which though they both enjoy the Benefit of Circulation of Juices, the one is much brisker and more lively than the other.

The Diſtance between one *whole Note* and another may be divided into very minute Parts; but thoſe who have to do with imperfect Inſtruments, ſuch as *Organs*, *Harpſicords*, &c. content themſelves only with *Semi-tones* and *Quarter-Notes*, in order to keep a tolerable Harmony in every *Key*; but a nice *Ear* may eaſily diſcover their Imperfection, eſpecially when they are ſtruck againſt a *Maſter-Note*. In perfect Inſtruments, ſuch as the *Violin*, &c. every *Key* may be ordered by the Artiſt who plays upon it, to expreſs any *Sound* with ſo great Exactneſs, that the *Ear* cannot diſcover the leaſt Diſorder or Imperfection of the Harmony, the Juſtneſs of which may be compared to a healthful Body; the Imperfection of the other to a Body diſtempered, where the Circulation is not juſt and regular; ſo we may learn, that where there is a familiar Gradation without Breaks, a Thing is natural, but otherwiſe unnatural.

To ſuppoſe that heavy Bodies can be raiſed on a ſudden, with the ſame Certainty that we could move them by gentle Degrees, would make us guilty of an Error. The *Jack*, the *Leaver*, the *Wedge*, and ſuch mechanic Powers, will, by gentle Operation, perform what the greateſt Strength cannot perform on a ſudden. A Man might jump down a Precipice and end his Life; but he might take Time, and walk perhaps a Mile or two, and gain the Bottom with Safety; it is natural therefore to go Step by Step. The Caſe is the ſame in *Animal* Bodies, but moſt remarkable in the Human Race; where, in Health, the Beats of the Pulſe agree with the Vibrations of a *Pendulum*; but were we to provoke that Natural Courſe of the Blood to a quicker Motion, by invigorating Diet, ſhould we not find the Body and the Senſes indiſpoſed, and even ſometimes by Violence rob the ſeveral Parts of their natural Functions, and thereby occaſion Death? Were we to examine the Circulation of *Liquors* in the ſeveral Kinds of Bodies animated, we find the *Squirrel*, and ſome others, to have naturally a much quicker Pulſation than Mankind; the *Snail*, and other *Inſects*, have a Circulation of Juices much ſlower; but muſt we therefore conclude, that a Man is in Health becauſe his Pulſe keeps Time, either with that of an healthful *Squirrel* or *Snail*? The Parts of every diſtinct Creature are ſo ordered by Nature, as to receive, in a certain Capacity, the *Liquors* flowing thro' them; but were thoſe *Liquors* to move either quicker or ſlower than Nature appointed, in each reſpective Body, the Body they moved in would be diſtempered.

Heat and Cold are comparative Terms. Fire we ſay is hot, and Ice is cold; but we ſay that Water is cold, and the Weather at *Midſummer* is hot; but this Heat, or this Cold, have their Degrees as much as Light and Darkneſs, or White and Black, or any other Colours. To ſay that a Thing is *Red*, is not to expreſs what Colour properly it is of; there is the *Carmine*, the *Lake*, the *Vermilion*, and *Red-Leads*, which ſhew us there are many Degrees of that Colour. Again, the Degrees of Heat are innumerable; one will melt *Gold*, another *Silver*, another *Copper*, another *Lead* and *Tin*, another *Roſin* and *Wax*, and a leſſer than theſe *Ice*. And now we come to ſay, that *Water* congeals into *Ice* by *Cold*; and, as ſome ſay, *Chryſtaline* Bodies are conſolidated by a continual extream *Cold*; but the hardening of *Water* into *Ice* happens only from a leſs Share of *Heat*, as the liquifying of *Wax* and ſome *Metals* is cauſed by a greater; ſo *Cold* is only a leſs Share of *Heat*, and ſo the contrary.

The Great and the Leſs have their gradual Differences. A *Grain* of *Sand*, and the Terraqueous *Globe*, one may ſuppoſe at a vaſt Diſtance from one another, with Reſpect of Magnitude; but alas! were we to make Compariſon between the *Globe* of *Earth* and the other *Planets*, we ſhould find a Difference almoſt as extenſive as between the *Grain* of *Sand* and our *Globe*; but between theſe Points of Magnitude there is Room in Thought for innumerable Diſtinctions; ſo is it in the Appointment of Numbers, they ſeem capable of infinite Diviſion and Increaſe. The *Tones* or *Notes* of Muſic are as diviſible. The gradual Increaſe of Mechanic Powers is as extenſive, and the *Vegetation* of *Plants* is as gradual, as well as the Life and Growth of *Animals*. It is therefore in this *Foundation* of *Natural Hiſtory*, I have ſuppoſed a *Scale of Life*, or a Chain of created Beings; for if our Reaſon tells us we ought to move gradually, there is certainly a *Gradation* in *Nature*, and therefore that gradual Motion is natural and reaſonable; and whatever is not ſo, is contrary to Nature and Reaſon; and I do not know a better Way of bringing the Unlearned to a right Judgment of Things, than by giving them a general View of Nature's Works, which at the ſame Time may lead them into the Way of Reaſon, and ſhew them the Wiſdom of the CREATOR.

All our Senſes are Witneſſes of the Gradations in Nature, by which we are taught to act with Gentleneſs and Deliberation in ſuch Things as are to be durable; for whatever is too haſtily gone about, or is forced to greater Speed than Nature appoints, muſt inevitably periſh before its due Time; and it is from a juſt Obſervance of ſuch progreſſive Methods as

Nature takes in the ordering and directing her Works, that our Reaſon is guided truly to our Advantage.

From Conſiderations of this Kind we may learn how ridiculous it would be to ſuppoſe, that becauſe a *Plant* cultivated in the Torrid Zone, required a greater *Heat* than we enjoy in our *Climate*, to ſupport it in a due State of Health, that therefore the Heat of a Furnace would give it a quicker Vegetation; or, to conclude, when we had killed a *Plant* or an *Animal* by an extraordinary Warmth, that therefore Nature directed it ſhould have none at all. There are certain Degrees to be choſen, agreeable to thoſe appointed by Nature, for the Support of each reſpective *Plant* and *Animal*; nor ought we to ſuppoſe, that becauſe we find a Gardener raiſes a proſperous Crop in one Place, we may have the ſame Succeſs in another, without thinking reaſonably upon the Difference of the Soil or Situation: But yet have I known many Inſtances of Men, who have been Sufferers, by acting without Underſtanding in Caſes of this Nature. Some, who have been inriched by a *Clay*, have been undone by following the ſame Rules upon a *Sand*; others have ſo far out-done *Natural Heat*, that they conſumed their Gardens, and deſtroyed all they had, without regarding that Nature has her Laws, which muſt be obeyed, and that ſhe acts with Gentleneſs, and will not be forced out of her Way. Thus it appears, that an Art is only the true Knowledge of Nature, and that thoſe who do not really know the natural Foundation of what they profeſs, are not Artiſts.

The more particular Uſe of this Scheme to Gardeners is, by directing them to conſider, that as every diſtinct *Animal* has its *Climate* and *Food* natural to it, ſo has every *Plant* an *Expoſure*, *Temper* of *Air*, and *Soil*, proper to nouriſh and maintain it in a right State of Health: And again, as we find ſome *Animals* to delight in the *Waters*, ſome in open *Air*, and ſome under the *Earth*; ſo are there *Plants* likewiſe that have their reſpective Appointments in the *Waters*, as the *Lens Paluſtris*, or *Duck-Meat*; and in the *Air*, as moſt *ſucculent Plants*; and even under the *Earth*, as the *Truffle*; ſo in all Plantations we make, we ought to obſerve what *Element*, *Situation*, and *Soil*, relates to each, if we would be ſure of Succeſs.

To judge rightly of the Method of treating *Plants* brought to us from ſeveral Parts of the World, I conſider *two* Things. *Firſt*, The *Soil* of the Country they grow in, which I would imitate as near as poſſible. *Secondly*, The Time of the *Spring* in the Country they are natural to, and as near as may be the Degree of *Heat* in that Time of *Spring*: For as every *Plant* has its appointed Times of Reſt and Growth, it would be unnatural to force its Growth, when Nature ordained its Repoſe;

or to abandon it to Repoſe, when it ſhould be aſſiſted by a Warmth agreeable to its own Country *Spring*.

To know the Time of *Spring* agreeable to every *Plant*, is to learn the Latitude of the Country it grew in; and in the next Place, to conſider the Degree of *Heat* natural to that *Climate* in the Time of its *Spring*. To judge of the Time of the *Spring* in every Country, is to obſerve in what *Zone* it lies; whether in the *Torrid Zone*, i. e. between the *Tropics*, or in the *Temperate Zones*, i. e. from each *Tropic* to the neareſt Bounds of the *Frigid Zones*, or from the *Polar Circles* even to the *Poles* themſelves.

The *Plants* which grow between the *Equinoctial Line* and the *Tropic* of *Cancer*, or to the Northward, (*i. e.*) towards us, we ſuppoſe to have their *Spring* as ſoon as our Days lengthen: And as the *Sun* comes towards us more and more, all the Places between that *Line* and the *Tropic* are gradually enlivened with *Spring*. At the ſame Time, while the *Sun* moves this Way to its *Boundary* or *Tropic*, which is about 23 Degrees North Latitude, the Influence of it has its Operations on every Thing gradually from the *Tropic* to the *Polar Circle*, and from that to the *Pole* itſelf: So that if we judge of the Latitudes, as they are gradually placed in the *Map*, and the Times and Degrees of *Heat* progreſſively moving thro' them, we cannot fail of giving every *Plant*, from any Part on this Side the *Line*, its Force or Warmth at the right Seaſon; and ſo we muſt maintain a due Regard to ſuch *Plants* as are Natives of thoſe Countries on the other Side the *Line*. When the *Sun* begins to leave us, their *Spring* is then coming forward, and every Day increaſes as much that Way, as we on the North-ſide of the *Line* decline into *Winter*; ſo that whatever *Plants* we have from thence, we ought to help at that Time, as we would our own in our own *Spring*.

We are moreover to remark, that as the *Sun*'s Motion and great Influence is between the *Tropics*; and that every Year its Motion is from South to North, and back again; ſo that Motion will produce two *Springs* every Year in each of the Countries it paſſes over; which *Springs* we may judge of, by enquiring into the *Sun*'s Courſe, which a common *Almanack* will ſhew us; and then allowing about 6 Weeks for the *Sun*'s Progreſs, before it can be directly over the Place we pitch upon, I ſuppoſe that will be the Time of *Spring* in that Country; for when the *Sun*'s Power is moſt violent in any Place, we find all *Plants* have finiſh'd their *Spring* Shoot, as we obſerve in *England* at *Midſummer*, when the *Sun* is neareſt to us. In the *Temperate Zones*, ſuch as we have the Happineſs to enjoy, tho' the *Sun*'s Influence is more moderate, yet we may obſerve that the greateſt Share of *Heat* only ſerves to ripen our Fruits; but it is the gentle Warmth gradually increaſing, like that of *April*, which makes our *Plants* vegetate.

When the *Spring-Shoot* is perfected, and the great *Summer-Heat* is over, Nature begins to make a ſecond *Shoot*; but that *Shoot* is ſeldom of any great Conſequence with *Us*; the *Sun's Heat* declines, when our *Plants* want it to increaſe, and the Attempt of Vegetation proves vain. I am of Opinion, were we then to give thoſe ſhooting *Plants* a convenient Shelter, and an additional *Heat*, regulated by a *Thermometer*, ſo that it ſhould be equal to that in the Month of *April*, we might even bring them to bear Fruit in the *Autumn* Seaſon. I have known ſome *Trees*, which, without any Help, have ripen'd ſome few Fruit of the ſecond *Spring*. It is common enough in *Strawberries*, *Rasberries*, and *Cherry-trees*, eſpecially if the *Bloſſoms* of the *Spring* have been taken off at their firſt Appearance.

When we have conſider'd the Time of *Spring* in the ſeveral Countries of the *Earth*, from whence we receive *Plants*, we are next to enquire the Degrees of *Heat* in each of thoſe Places at the Time of their reſpective *Springs*, which we muſt imitate as near as poſſible; and I obſerve, that our *Midſummer-Heat* is powerful enough to maintain any *Plant* brought us from between the *Tropics*; therefore, as we have it in our Power to give that Degree of *Heat*, at any Time of the Year, by means of Fire, we may keep any *Plant* even from under the *Line*, in our Conſervatories, regulated by a *Thermometer*, at our *Midſummer* Degree of *Heat*, which I ſuppoſe will agree well enough with the *Spring Heats* in thoſe Countries lying between the *Tropics*; and at the ſame Time I would have an *Hygrometer* in the ſame Stove or Conſervatory, by which we might regulate the over Moiſture or Damps in the Air of the Houſe.

The Air in *England* is generally ſo temperate, or the Paſſage from the *Heat* to the *Cold* is ſo gradual, that *Plants* which naturally grow 8 or 9 Degrees more South than we are, will grow here without any Shelter; but indeed they have this Advantage, that the Time of their natural *Spring*, or awaking from their Reſt, is but a little different from the Seaſon of our *Spring*; ſo that when Nature appoints them to make their Shoot, the *Sun* is coming towards us, and retards them in their Attempt.

In my *Kalendar* of *Gardening* I have given a Deſign of a Green-houſe or Repoſitory for *exotic Plants*; but for the Preſervation of the moſt tender Kinds, ſuch as grow near the *Line*, there is no one does ſo well as that contrived by the curious Monſieur *Le Cour* of *Leyden*, for the Production of that moſt excellent Fruit called the *Ananas*, or *Pine-Apple*, from whoſe Model there are 2 or 3 now built in *England*.

I think I have ſaid enough to inform my Reader how neceſſary it is to obſerve the Laws of Nature in the Preſervation of created Bodies,

dies, tho' I am not inſenſible that even the Contemplation of one created Body alone would afford Matter ſufficient for a large Volume; but my Deſign being only to exhibit a general View of Things, rather than to enter upon Particulars with too much Freedom, I chuſe to leave the Enquiry into the more nice Parts to the Curious, who have Leiſure and Opportunity to obſerve them.

I ſhall conclude with ſome Particulars relating to MANKIND, who, altho' he be Lord of All, and has a Power of governing every living Creature, yet has he many Particulars in his Frame which bear Analogy with the Parts of thoſe Creatures he is ordained to govern. The Harmony which Nature maintains in the Generation and Production of *Quadrupedes*, is not contradicted in HIM. The Functions of ſeveral Parts in Brutes direct to perform what the ſame Parts would do in Mankind, was he not indued with Reaſon to guide him in his Actions, and over-rule what is brutal in him. But this is a Matter which relates more particularly to thoſe who make it their Buſineſs to conſult the Health and Welfare of Men, rather than their Natural Hiſtory, which is my preſent Subject. I ſhall therefore content myſelf with obſerving only ſome remarkable Particulars, which are not commonly taken notice in the Human *Species*.

The Longings in Women, and the Marking of Children, are Subjects which have occaſioned

Diſputes among the Learned; but I do not find either of thoſe Caſes yet determined, ſo that I cannot well omit a Conjecture or two of my own relating to thoſe Subjects. I ſuppoſe when a Woman is pregnant, there is a regular Circulation of Juices thro' the Bodies of both the *Mother* and the *Fœtus*, admitting only that the Parts of the *Fœtus* ſubſiſt or are ſupported by ſuch fine Juices as we may ſay are diſtilled from the Blood of the *Mother*; for the Parts fully grown are undoubtedly more capable of giving Paſſage to more groſs Juices than thoſe which are in *Embryo*, and in ſuch a minute Body; and in the *Fœtus* muſt be as fine as a ſubtle Vapour, almoſt equal to thoſe Spirits which nouriſh the *Brain* of a full-grown Body.

The *Fœtus* has its Head firſt formed, and that, as well as all the other Parts, is regularly ſupplied with Juices from the ſeveral Parts of the *Mother*, as they are analogous to one another; therefore, I ſuppoſe, as the *Brain* both of the *Mother* and *Fœtus* have an immediate Communication with one another, ſo I imagine the extraordinary Deſire of the *Mother* has ſo immediate an Effect on the *Brain* of the *Fœtus*, that it becomes diſtempered, and conſequently muſt affect the *Brain* of the pregnant Woman, and ſo both are out of Order.

Again, the pregnant Woman, by touching any Part of her Body, when a ſtrong Deſire of any thing *predominates* in her *Imagination*, muſt have an extraordinary Power over the

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Plate XVIII.

Fig. III.

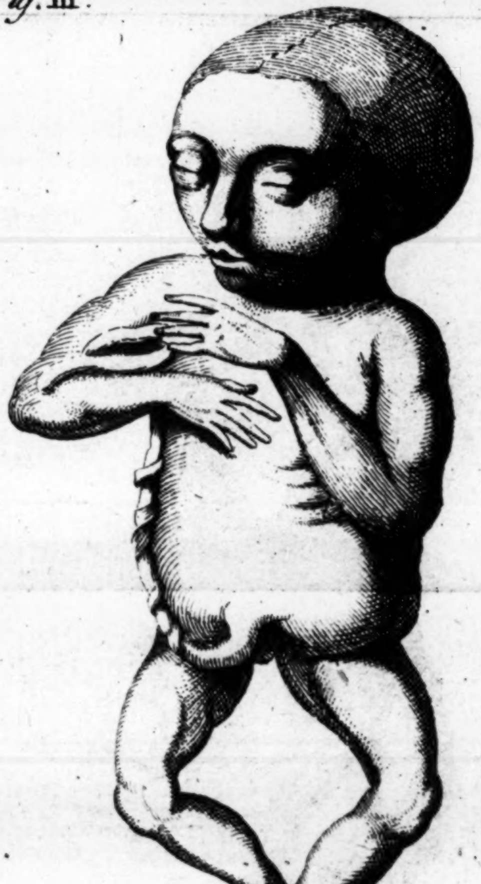


Fig. II.

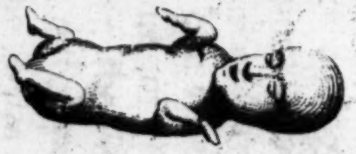
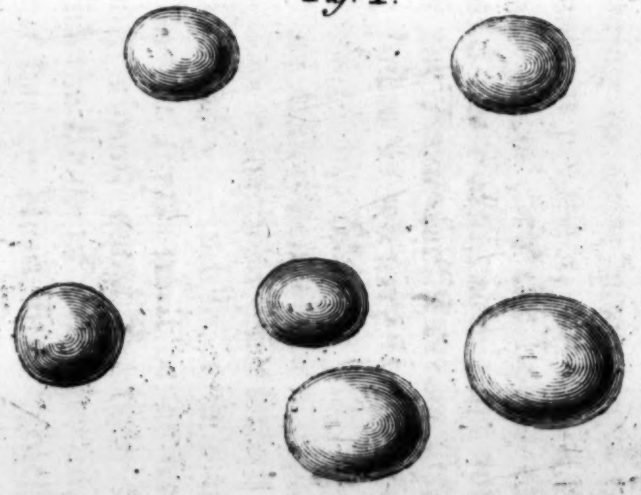


Fig. I.



ſame Part of the *Fœtus*, and eſpecially becauſe Things ſo ſmall and flexible will ſooner take an Impreſſion than others which are perfected; but this by way of Hint to the Learned. I proceed next to obſerve the ſeveral Kinds of Men, whoſe Difference is remarkable.

There are 5 Sorts of Men; the *White-Men*, which are *Europeans*, who have *Beards*, and a Sort of *White-Men* in *America* (as I am told) who only differ from us in having no *Beards*. The 3d Sort are the *Mulattoes*, which have their *Skins* almoſt of a *Copper* Colour, *ſmall Eyes*, and *ſtrait black Hair*. The 4th Kind are the *Blacks*, who have *ſtrait black Hair*: And the 5th are the *Blacks* of *Guinea*, whoſe *Hair* is curled, like the *Wool* of a *Sheep*. Such are the Marks of Diſtinction; and the Behaviour obſerved between rude and civilized Nations, is to be wholly attributed to the Arts of polite Education.

Explanation of the Figures relating to Chapter XIV.

PLATE XXVIII.

Fig. I. *The* Eggs *taken from the* Ovary *of a* Woman; *by Dr.* Douglas.

Fig. II. *An Human* Fœtus *before Quickening, from the* Royal Society'*s Collection.*

Fig. III. *An Human* Fœtus *after Quickening, from the ſame.*

PLATE XIX.

Fig. I. *A* Skeleton *of a* Man, *whereby the Difference in the* Oſteography *in the* Man, *and other Creatures, may be obſerved.*

Fig. II. *The* Skeleton *of a* Monkey, *ſhewing the Difference between that* Creature, *and the* Human Species.

CHAP. XV.

An Account of ſuch Lands in England *as are ſtiled* Barren, *with ſome Propoſitions tending to their Improvement, and ſome Remarks relating to* Fiſh-Ponds.

IN my Book of *New Improvements in Planting, &c.* I have endeavoured to excite our *Engliſh* Nobility to plant Timber, as well for the Uſe of their own Families, as for the publick Good; and ſince I find that Work has not been diſagreeable, I am the more ready to publiſh what I have ſince obſerved in the Culture of profitable *Trees*, and the Method of Improving what we now call *Barren-Lands*. I have often viewed our *deſolate Foreſts*, and *barren Plains*, with an Eye of Pity, conſidering how much we were at the ſame Time beholden to diſtant Nations for thoſe Commodities, which might with Eaſe be cultivated in our own Country, and

Plate XIX.

Fig. I.

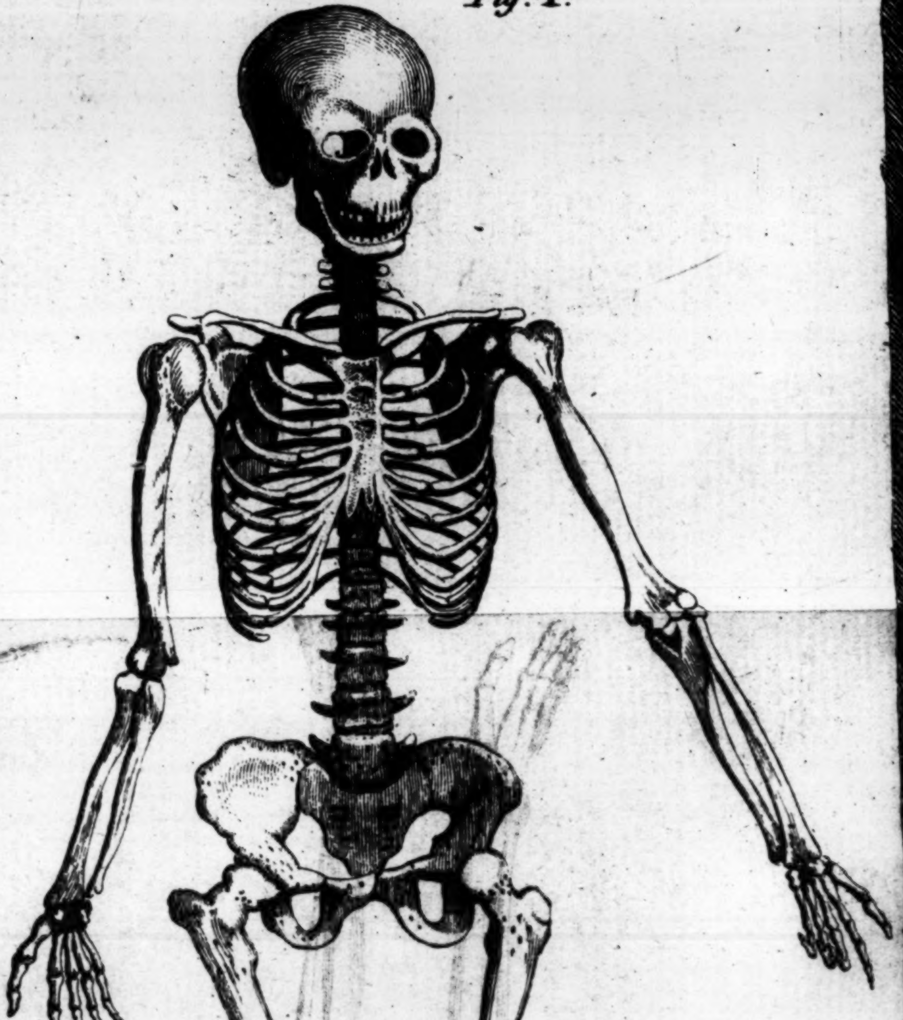
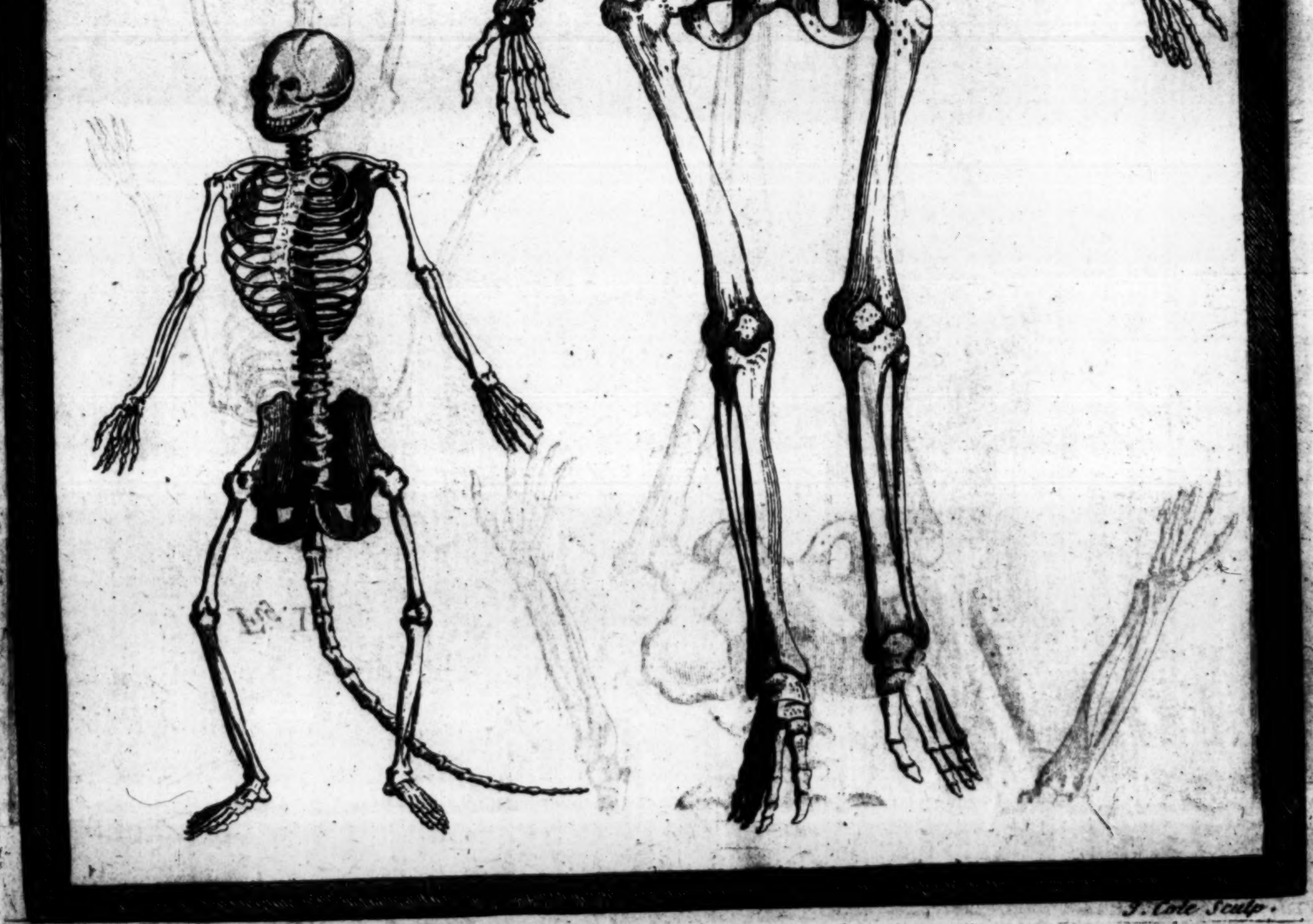


Fig. II.


J. Cole Sculp.

and which might turn to great Profit, and ſecure us from the Aſſaults of incroaching Neighbours.

In my Travels about *England*, I obſerved that we have 3 ſorts of Soil, which are generally accounted unprofitable, ſuch as *Heath-Grounds*, *Chalky-Hills* and *Plains*, and that which affords only what is called *dead Sand*. Some of the *Foreſts* indeed yield good profitable *Land* for *Corn* and *Paſture*, and have formerly borne valuable Burthens of *Trees*; as have alſo ſome *Grounds* belonging to private Gentlemen, from whence, upon Emergencies, have been reaped conſiderable Crops of *Timber*, whoſe Price has even overbalanced the Worth of the *Ground* it grew upon. And we have many late Inſtances of Eſtates which have been ſold, whereon, in a few Years afterwards, the *Timber* produced has yielded more Money than was given for the whole Purchaſe of the *Land*. In my former Works upon this Head, I have rated *Land* for *Timber* at 5 s. *per* Acre; but ſuch *Lands* as I am here treating of have been ſold for 1s. *per* Acre, and leſs.

The *firſt* I ſhall take notice of are the *Heaths* in *England*, which at preſent ſcarcely yield Food enough for *Sheep*, and are of no other Uſe. This ſort of *Land*, which is generally ſandy, and in which commonly we find abundance of *moraſs Ground*, I adviſe to be cultivated for the propagating of *Fir-Trees*, which are of very quick Growth, uſeful, and agree well with ſuch *Land*. We have ſome Inſtances of this ſort of *Land*

Land cultivated in this manner; but in *Germany*, and ſome of the North Parts of *Europe*, we find whole *Foreſts* of *Firs* growing in this kind of *Soil*. At the Earl of *Alresford*'s, near *Guilford* in *Surrey*, we have an Example of the good Thriving of theſe *Trees* upon a *Hill* of common *White Sand*, (in which one could hardly expect the leaſt *Vegetable* Quality) and yet they have not been planted quite 30 Years, tho' they are now above 40 Feet high: But it is to be obſerved, they are hardly 6 Feet aſunder, which may be the Occaſion of their extraordinary Height, and the Clearneſs of their *Stems*, without Knots. The Experience I have had of this *Tree*, eſpecially of the *Scots Fir*, teaches me, that it thrives better raiſed from *Seed* upon the Spot where it is deſigned to remain, than if it be tranſplanted.

To make a Seminary of theſe *Trees*, we gather the *Cones* or *Fruit* of them in *September*, even while their *Rind* partakes yet of a *Green* Colour; for thoſe *Cones* which are already cracked and opened, produce little or no good *Seed*. The *Cones* being thus gathered, we lay them in a dry Place during the Winter, and about *February* either expoſe them to the Sun till they crack and open, or elſe put them in ſome Veſſel into an Oven after the great Heat is gone off. By either of theſe Ways we come at the *Seed* without Difficulty, as I have tried with good Succeſs; tho' ſome have been apt to ſuſpect, that thoſe *Cones* and *Seeds* which are opened

pened by the Heat of an Oven, would be too much dried to *vegetate* or *ſpring* in the *Ground:* When theſe *Seeds* are well cleaned, we ſow them thin in Beds, covering them about half an Inch deep with fine Earth, and in a Month's Time they come up; but we muſt take great Care at their firſt Appearance to preſerve them from *Snails*, which are their worſt Enemies. The ſame Summer they ſhoot hardly more than an Inch; and as their *Roots* lie very near the Surface, it is adviſable to ſift *Sand* over the Beds near half an Inch thick, about *September*, to keep them ſteady, and prevent the Froſts from turning them out of the *Ground*. The 2d Year they make *Plants* of about 4 Inches high; and if they were to remain in the ſame Bed the 3d Year, they would be near a Foot taller; but I hold it much better, if any of them are to be removed, that it ſhould be done when they are 2 Years old, and even then with extraordinary Care, laying them in a Barrow or Caſe of Earth, to be tranſported to the Place appointed for the Great Plantation; and obſerve, that we do not take them out of this Earth, till the very Inſtant, if poſſible, that we are to place them in the Station where they are ever after to remain; for a little Air dries and ſhrinks the Coat of their *Roots*, and their *Parenchymous* Parts; ſo that they remain for a Time without the Power of Growth, and perhaps rot or grow diſtempered by a Stagnation of the Juices. In this Plantation I would not adviſe to ſet them more than 6 Feet apart; which would be a Means, as I have obſerved before, of their growing ſtrait and tall, unleſs indeed we would run the Hazard of tranſplanting ſome of them a ſecond Time, and then the Diſtance between them need not be above 3 Feet, which would yet contribute ſo much the more to their aſpiring and upright Growth, during their juvenile State. They might remain in this Manner about 5 or 6 Years, and then it would be high Time to draw every other *Tree* to make Room for the reſt. The Method which has been uſed for tranſplanting *Fir-Trees* of this Age, and even ſome Years beyond it, with good Succeſs, was invented by the honourable *James Johnſton* of *Twickenham*, Eſq; who about *Midſummer* tranſplanted ſome of theſe *Trees* above 20 Feet high, in a Preparation of *Earth* and *Water*, of the Conſiſtency of a thin *Mud*, filling it up with fine *Earth*, till the *Root* of the *Tree* was firmly ſettled in it. By this Means, the *Trees* ſo planted, had made Shoots on their Tops above a Foot long the following Year, before the others, (which remained in the Nurſery) had even begun to ſhoot.

I have before taken notice of a new-invented Method of tranſplanting *Trees* with Safety, by Means of a *Vegetable Mummy*, or Compoſitions of *Pitch*, *Bees-Wax*, *Turpentine*, and ſuch like; and I believe it would be of no ſmall Uſe in this Caſe, eſpecially if we were to tranſport *Trees* to any great Diſtance. The anointing the

Roots with ſuch Preparations, and eſpecially thoſe Parts where they have been cut or wounded, would keep them from drying, or ſhrinking up by the Air or Sun, and even contribute ſomewhat to their Growth. For the *Fir*, indeed, I rather recommend the anointing the *Roots* with *Turpentine* alone, or elſe mixed with *Tallow*, which might eaſily be done with a Bruſh when it was warm; for the *Turpentine* I ſuppoſe cannot fail of giving ſome Nouriſhment to the *Tree* which naturally produces it; and the *Fat* of *Animals* is generally allowed to aſſiſt *Vegetation*, as I have before obſerved, where I recommend the Uſe of *Soap*, to anoint the *Roots* of *Vegetables*, to which I refer.

The *Scots-Fir* and *Pinaſter* are what I chiefly would adviſe to be planted for *Timber*, in *Sandy* and *Heathy Ground*, as they are both able to maintain themſelves in Variety of Seaſons. I have ſeen both theſe Kinds yield profitable *Timber* for *Plank* or *Boards* in 40 Years from the ſetting, as the People now living have aſſured me, that ſaw them planted and raiſed from *Seeds*. A Gentleman of *Devonſhire* has now many of them growing upon a *red Rock*, where they thrive exceedingly; ſo that the *Hills* in *Derbyſhire*, and ſuch as are rocky like them, need not deſpair of bearing one Time or other this profitable Burden. But leaſt 40 Years ſhould be thought too long Time to wait, without receiving any Advantage, let us conſider the *Ground* was before the Plantation good for little or nothing; and in half that Time, the *Plants* which may be drawn out to thin the reſt will be fit for Scaffolding, or ſome other Uſes; and all this while, the growing *Trees* are increaſing in their Value, without any Expence or Labour, more than the firſt Charge.

But as *Heath Ground* is the Soil I propoſe for ſuch Plantations, and is for the moſt Part in Common, it will be difficult to incloſe it. I think, however, the beſt Method to overcome that Difficulty, would be to *ſummon* the Poor of the Pariſh, who have chiefly *the Right of Commoning*, and *parcel out* ſuch *Land* in as many Lots as there are Perſons who can juſtly claim a *Right to* it; and then the Choice among them, of the reſpective Parcels of *Land*, to be made by balloting, or elſe let them chuſe according to their Seniority, or the Length of Time that each of them, or their Families, have been Inhabitants of the Pariſh: By this Means every one of theſe poor People would find Matter of Employment, and become Poſſeſſors of *Land*, which they might juſtly call their own, and thereby have Encouragement to cultivate and improve it: Theſe People ſtill being tributary to the Lord of the Manor, in proportion to the Value of ſuch Lands as they hold, and to be obliged alſo to plant a certain Number of ſuch *Trees* for *Timber* as the *Land* will beſt nouriſh. It is my Opinion, that many of our Poor, which at preſent are troubleſome and expenſive, may by this Method be rendered uſeful to the Publick, and live in a contented State, enjoying every Man his own Right, without Incroachment from his Neighbours, or being ſubject, as the Commoners now are, to have the Benefit run only into a *few* Hands, while perhaps thoſe who have the greateſt Right have hardly Paſture enough for 6 *Sheep*, when others find Subſiſtence for 2 or 300.

Another Way, which might tend to the Improvement and propagating of *Timber*, would be by obliging every Tenant at the renewing of his Leaſe, to plant certain Numbers of *Trees* at his own Expence. Where any conſiderable Plantation happens to be made, I would adviſe a *Stone* to be ſet up, with an Inſcription, denoting the Year, the *Seaſon*, and by whom planted, that it might be an Inſtruction to future Ages how long ſuch *Trees* had been growing, to produce the Sum they might then be ſold for, and inform the Succeſſor of the Perſon's Name, who ſo wiſely had the Foreſight to provide for him.

The other Sort of *Ground*, which next falls under my Conſideration, is the *Chalk*, ſuch as we obſerve, for the moſt Part, on *Saliſbury-Plain*, and the waſte Grounds about *New-Market*; and I much wonder, conſidering the great Scarcity of *Timber* and Fire-Wood in thoſe Countries, that no body has yet began any Plantation thereabouts, eſpecially ſince we have ſo many Inſtances of *Hills* and *Lands* of the ſame Kind of *Chalk* in *Berkſhire*, *Oxford-*

ſhire, *Buckinghamſhire*, &c. which are covered with ſtately *Trees*, as well for *Timber* as Fire-Wood. We there find the *Beech* is natural to that Kind of Soil; and in ſome Places the *Engliſh Cheſnut* thrives pretty well, and the *Oak* indifferently; but the *Wallnut* rejoices in that Soil, if it has any tolerable Shelter. I would recommend therefore to ſuch Gentlemen as have Eſtates about *Saliſbury* and *New-Market*, to take the *Hills* and *Chalky Grounds* of *Berkſhire*, &c. for their Example, and cultivate their *Lands*, which are of the ſame Kind, after the ſame Manner; ſo that in Time they may ſave the Expence and Trouble which they are now at, in ſending many Miles for their *Firing* and *Timber*.

The *Beech*, which is a Lover of this Soil, grows much quicker in it than in ſome *Lands* which are counted much richer, and is raiſed from the *Maſt* without any Difficulty, carrying this Conveniency along with it, that the *Seed* does not come up till the 2d Year; ſo that upon the firſt ploughing of the *Ground*, we may ſow the *Beech-maſt*, and ſome Kind of *Grain* at the ſame Time, and reap a profitable Crop of *Corn* before the young *Beech* appears, to bear the Expence we have been at in laying up the Ground. In 12 or 14 Years we may begin to reap ſome Advantage from this new *Wood*, by cutting and thinning ſuch of it as is fit for *Firing*. If we had an 100 Acres planted in this Manner, we might cut about an 8th Part at one

Time, and at that Rate have a continued Supply from Year to Year; the firſt growing up by that Time we have cut the laſt; and the laſt renewing itſelf again by that Time the other 7 Parcels have had their 2d Cutting.

The *Engliſh Cheſnut* is likewiſe a very profitable *Tree*; and though I have already mentioned it in my *New Improvements of Planting*, &c. yet I cannot help taking notice of the extraordinary Bulk that *Tree* will grow to. Mr. *Greening*, a very ingenious Nurſery Man at *Brentford*, tells me, that at the Seat of the Lord *Ducie Moreton* at *Tartworth* in *Glouceſterſhire*, there is now growing an *Engliſh Cheſnut*, which he meaſured, and found the *Girt* 51 Feet about, 6 Feet above Ground. This *Tree* divides itſelf at the *Crown* into 3 *Limbs*, one of which he meaſured 28 Feet and a half in the *Girt*, 5 Feet above the *Crown* of the *Tree*; which extraordinary Meaſure of the *Limb* only, is almoſt equal to the biggeſt *Oak* in *England*. He obſerved that the Soil was a ſoft *Clay*, ſomewhat loomy, and the Situation on the *North-Weſt-Side* of a *Hill*: This *Tree*, he tells me, was mentioned in a Book Dedicated to King *John*, and was then ſtiled the *Great* or *Old Cheſnut Tree* at *Tartworth*; ſo that it is ſuppoſed it muſt be above a 1000 Years old. At the ſame Seat, near the Place where this wonderful *Tree* now grows, my Lord *Ducie* told him he lately cut down an *Elm*, out of whoſe *Limbs* were made 100 Pair of Stocks for Cart-Wheels, and whoſe

Body was ſold for 22 Guineas upon the Spot; from whence we may learn how a *loomy Soil* contributes to the Growth of theſe Kind of *Trees.*

In *Marſhy Grounds* the *Oſier*, *Alder*, and *Arbeel*, turn to good Account; and may every one of them be raiſed from *Cuttings*, or *Truncheons* ſet in the *Ground*, (as I have directed in my Book of Gardening) even tho' it be covered 2 or 3 Feet deep with Water; eſpecially the *Oſier* and the *Alder* would in Time, by the matting or entangling of their *Roots*, and continued Fall of their *Leaves*, bring it to ſolid *Ground*; but *Water* in ſome Caſes is as profitable as the *Land* itſelf, as I ſhall ſoon obſerve; but firſt let me adviſe that where *Banks* are neceſſary to keep *Land* from the overflowing of adjacent *Rivers* or *Lakes*, there is no Way of making them ſo ſolid and laſting, as by Backing them well with *Stakes* of *Willows*, which ſtrike *Root* without any Trouble, and intermix with one another in ſuch a manner, that in a few Years only they become as one Body.

I come now to ſpeak of *Fiſh-Ponds*, and to mention ſome Obſervations concerning the Number of *Fiſh*, which a certain Quantity of *Water* will maintain. It has been obſerved, that every Kind of *Fiſh* requires a certain Depth of *Water* to maintain itſelf in; the ſmaller Sorts delighting and thriving in ſhallower *Waters* than the greater; and theſe *Waters* are more or leſs nouriſhing to ſome *Fiſh*, as they paſs thro' different *Strata*, or Beds of *Earth*, every Kind of *Earth* giving its *Tincture* to the *Waters* paſſing thro' it, or joining with it. The moſt nouriſhing *Waters* for *Carp*, are ſuch as are found in *Heathy-Grounds*, which are commonly of a *Sandy Soil*; and if it is poſſible to chuſe the Situation of a *Pond*, it is counted much better to have it near the Bottom of *Hills*, that upon the Fall of great Rains may waſh down *Inſects*, and other nouriſhable Matter into it; and if it could be contrived, the *Water* ſhould be always current thro' it; where this happens, the ſame Fund of *Water* will maintain one third part more *Fiſh* than it would do, if it was only a ſtill *Water*. In the making of a *Pond*, we ought to contrive, that it may have all Degrees of Depth as far as 6 Feet; for if the *Fiſh* happen to breed in it, the young *Fry* or *Spawn* muſt have ſhallow *Water* to live and ſwim in; and the *Spawn* itſelf, while it is in the *Egg*, would be unfruitful, was it to lie in deep *Water*. Again, as the young *Fiſh* grow bigger, they change their Station more and more towards the Deep, till they become of a fit Size to breed and produce others. It is rarely known, that in a good breeding *Pond* the *Fiſh* ever come to be very large; for the Number of them become ſo great, that they over-ſtock the *Water*, and are ſtraitened for Food. I have been told, that where the ſhalloweſt Part of a *Pond* is about 2 Feet in *Water*, that neither *Carp*, *Pike*, *Tench*, or *Perch*, will breed in it,

becauſe

becauſe it is too deep for the *Spawn* to hatch, if the *Fiſh* ſhould be inclined to lay any; and in ſuch Places an ingenious * Gentleman obſerves the *Fiſh* grow very large, and thrive a-pace, if they were at firſt rightly proportioned to the Quantity of *Water*, and put in at a right Age. An Acre of *Water*, he tells me, (if all the Parts of the *Pond*, one with another, meaſure 3 Feet deep) may well enough bear 90 Brace of *Carps*, which is about a Rod of *Water* to each *Fiſh*; or elſe, as he obſerves, 80 Brace of *Carps*, and 20 Brace of *Tench*, and ſo in Proportion for every 10 Brace of *Carp* wanting, he allows 20 Brace of *Tench*. Theſe *Fiſh*, he ſuppoſes, delight to be together; and remarks, that the *viſcous* Matter upon the Bodies of the *Tench* is often ſerviceable to ſuch *Carp* as have by Accident been wounded. It is found by Experience, that both theſe Kinds of *Fiſh* thrive much better in old *Ponds*, than thoſe that have been newly made; and he gives this Reaſon for it, That in a *Pond* newly cut or dug, the Water is not all of one Piece, or partaking of the ſame Qualities, which it muſt have ſufficient Time to draw from the Earth, and circulate through, or mix with every Part alike of the *Water*; for he holds it as a Maxim, that *Fiſh* never thrive which have any Change of *Water* after they are 2 Years old, and therefore always ſtocks his *Ponds* with Store of the 2d Year. To experience this, he told me, that in one *Pond* he put in at the ſame Time *Carps* of the old, marking thoſe of the two laſt Age: Five Years afterwards he drew the *Pond*, and found that the young *Fiſh* of the 2d Year were much larger than any of the others; which happened, as I ſuppoſe, for the ſame Reaſon that young *Plants* are more eaſily tranſplanted, and thrive much better, than elder *Plants* that have ſtood long enough in a Soil to be naturalized to it; or that People, who have been bred up from their Infancy, and a long Time breathed their native Air, grow ſickly upon changing it; juſt ſo does the changing of *Fiſh* from one *Water* to another alter their Conſtitution. It is likewiſe obſervable, that a Plantation of *Trees* too near a *Pond* is apt to infect the *Water* with its falling *Leaves*; but, on the other Hand, Shelter is neceſſary, and is much the beſt, as it conſiſts of *Herbs* and *Plants*, which naturally grow in the *Waters*, ſuch as *Water-Lillies*, *Pond Weeds*, and *Flags*, which feed and afford a great Number of *Inſects* for the *Fiſh* to feed upon, and help to guard them from the too great Heats of the Sun; but chiefly I am told theſe *Weeds* are uſeful to *Pike* and *Perch*, and that they are better fed *Fiſh*, and much larger in ſuch *Ponds*, than where they have only a naked *Water*. The *Pike* being a

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* The late ingenious and honourable *Roger North*, Eſq; of *Rougham*, in *Norfolk*, hath written a moſt excellent *Diſcourſe* of *Fiſh* and *Fiſh-Ponds*, printed in the Year 1713; to which we refer for the *Breeding* and *Feeding* of *Fiſh*.

Fiſh of Prey, will admit of no *Fiſh* to abide with it but the *Perch*, and that only avoids the voracious Appetite of the *Pike*, by Means of the thorny *Fins* on its Back. In theſe *Ponds* however it is a common Practice to fling in a Parcel of *Roach* for the Food of the *Jacks*; and I knew a Gentleman, that thought it worth his while to ſtock his *Pike-Ponds* with *Frogs* for the ſame Uſe. Theſe, as well as the *Carp* and *Tench*, may be fed with Blood and Bran mixed together, Raſpings of Bread, or the Entrails of *Fowl* or *Sheep*; and if they are regularly uſed to be fed in this Way, at a conſtant Hour and Place of the *Pond*, they will in a ſhort Time become undaunted, and feed before us, which is all I ſhall ſay at this Time relating to *Pond-Fiſh*.

CHAP. XVI.

Of the moſt curious Gardens *in* Europe, *(eſpecially in* Britain) *and what may be learnt particularly from them; with ſome New Remarks and Experiments relating to the Improvement of* Fruit-Trees *and* Flowers.

BESIDES the innocent Diverſion which is found in a *Garden*, by cultivating many of the greateſt Beauties of the Creation, Mankind may gain immediate Advantage in reaping the *Fruit* of his Labours. The Health of the Body is moreover maintained or encouraged, if we lend our helping Hand towards the propagating of *Vegetables.* A gentle Exerciſe in a Freſh Air, where the Mind is engaged with Variety of natural Objects, contributes to Content; and it is no new Obſervation, that the Trouble of the Mind wears and deſtroys the Conſtitution even of the moſt healthful Body. All Kinds of *Gardens* contribute to Health; but every one is not equally advantageous or profitable. There are *Gardens* of Grandeur and Recreation, ſuch as thoſe expenſive ones at *Verſailles, Marli* and *Trianon,* belonging to the King of *France*; and in *England,* the Royal *Gardens* at *Kenſington,* and *Richmond.* The *Gardens* at *Kenſington* have not indeed the Extent of thoſe which I mention in *France,* nor had the Director of them the Happineſs to make them All at one Time, but was content with giving now and then a Beauty as Occaſion offered. The Irregularities which I remember were in the Ground, when he took the laſt Part of them in Hand, have particularly ſignalized his Judgement; ſo that we are led to an Imagination of the Beauties that would have appeared in them, if they had ſtill been more irregular when he undertook them.

The Royal *Gardens at Hampton-Court,* are famous for the Variety of *Exotic Plants* brought from moſt Parts of the World, but more eſpecially for the Healthful Condition of them, and exact Symmetry in the diſpoſing them in their ſeveral Conſervatories; and it is here that we have

Examples of *Orange-Trees* bearing Plenty of *Fruit*, in as great Perfection as we can deſire, which ſurpaſſes any at *Verſailles*; ſo that we may judge how much the Skill of a Director is neceſſary to contrive and manage in ſuch a Caſe; for tho' the *Trees* at *Verſailles* are extraordinary large, and in great Numbers, they were without *Fruit* when I was there; ſo that I cannot enough commend the Ingenuity of our *Engliſh* Artiſt.

The *Verſailles Gardens*, as they are of vaſt Extent, and have coſt immenſe Sums, it is needleſs to deſcribe their Particulars; but in general we may ſay this of them, that their Order and Contrivance has been as well poetically as mathematically ſtudied; each reſpective Part has a juſt Proportion with the Hiſtory repreſented in the Statues and Water which it contains; ſo that we never obſerve too many, or too few Statues, or more or leſs Water than the Imagination can expect; and ſo near Nature is the artful Contrivance of theſe *Gardens*, that we are led with Expectation and Deſire throughout the whole; but we muſt ſtill obſerve, that in this Wonder of a *Garden* there is neither *Graſs*-work nor *Gravel*, nor the beautiful Ornament of variegated *Hollies*, which is the Glory of *Engliſh Gardens*.

Was I to give a particular Deſcription of our *Engliſh Gardens* for Pleaſure, which the Curious, among our Nobility and Gentry, have brought to Order; a large Volume would not contain it. Some are happy in their Situation for *Caſcades* and *Jet d'eaux*; others have their Beauties in agreeable Proſpects; and ſo likewiſe was I to deſcribe particularly the *Gardens* in *France*, we ſhould find them abound in natural Beauties, and only wanting of thoſe Ornaments in which we exceed moſt other Parts of *Europe*, viz, *Graſs*, *Gravel*, and Variety of hardy *Ever-Greens*. Again, the *Gardens* in *Holland* have very different Appearances and Modes from thoſe in *England* and *France*; the *Holland Gardens* are not indeed without Water, but it is commonly ſuch as is of no Uſe either for Water-works, or common Service to the *Plants*; for the Country is level, and the *Canal* Water commonly ſalt or brackiſh, ſo that I have often ſeen Boat-Loads of freſh Water brought from a great Diſtance; but the *Canals* which encompaſs and bound the *Gardens* have a very good Effect, being aſſiſted with the Ornaments of *China*, and gilt Pots and Vaſes, with Statues, and Arbours or Cabinets of *Lattice* Work, which together afford an agreeable Proſpect; but *Holland*, no more than *France*, poſſeſſes the Beauties of fine *Graſs-Turf*, or *Gravel*, or the Ornament of our *Engliſh Ever-greens*; nor indeed is the Soil ſo natural to moſt *Herbs* of the *Kitchen-Garden*, as it is generally in *England*; which one may eaſily obſerve, by comparing the Produce of one with the other; but for bulbous *Roots*, we find it to produce Wonders, which has given me Occaſion to conſider the Nature of that Earth more particularly: It is compoſed of fine *Sea Sand*, with a Mixture of *Turf* or *Peat-Earth*, which ſeems to be *two* Thirds of the former, and *one* of the latter; and the Benefit of this Kind of Soil in propagating Bulbous *Roots*, has made the *Hollanders* famous, eſpecially in *Tulips*.

I have lately obſerved, that our *Heath-Ground*, which is moſt like the *Holland Soil*, yields very good *Saffron*, and even produces a better Crop than the *Chalky* Soil about *Saffron-Walden*. Upon the latter, an Acre of Ground, in its full Strength, brings about 12 Pounds of *Saffron* in a Seaſon; but the *Saffron Roots* in the *Heath Ground* bring more *Flowers*, about one 6th Part. It is to be noted, that all the *Saffron Grounds* are ſubject to be deſtroyed by *Hares*, and therefore are incloſed with *Hurdles*: And again, the *ſecond* or *third* Years of planting thoſe *Roots* give the greateſt Crops; for they muſt be ſeparated or tranſplanted after the third Year's bearing, or elſe they produce little. But to proceed.

The profitable *Gardens* are of *three* Kinds; *firſt*, thoſe cultivated for *Kitchen* Uſes; *ſecondly*, the *Nurſeries* for Improvement of *Timber*, *Fruit*, &c. and thoſe which are diſpoſed for the Uſe of Phyſick, and are the *Seminaries* and *Nurſeries* of *Exotic Plants*.

The *firſt*, which are *Kitchen Gardens*, and exceed all the other *Gardens* in *Europe* for wholſome Produce, and Variety of *Herbs*, are thoſe at the *Neat-Houſes* near *Tothill-Fields, Weſtminſter*, which abound in *Sallads*, early *Cucumers*, *Colliflowers*, *Melons*, *Winter Aſparagus*, and almoſt every *Herb* fitting the Table; and I think there is no where ſo good a School for a *Kitchen Garden* as this Place; tho' *Batterſea* affords the largeſt natural *Aſparagus*, and the earlieſt *Cabbages.* Again, the *Gardens* about *Hammerſmith* are as famous for *Strawberries*, *Raſberries*, *Currants*, *Gooſberries*, and ſuch like; and if early *Fruit* is our Deſire, *North-End*, near the ſame Place, affords us *Cherries*, *Abricots*, and Curioſities of thoſe Kinds, ſome Months before the natural Seaſon. I could mention ſeveral particular *Gardens* about *London*, where I have found an Excellency in the *Gardeners* belonging to them; but as there are Accidents which happen every Day, that may occaſion the Removal of the Artiſts from thoſe Places, it will be of little Uſe to name them.

The *French*, in their *Kitchen-Gardens*, propagate *Muſhrooms* in large Quantities; and, indeed, about *Paris*, the Gardens are chiefly employed in this Way, ſo that the Markets are plentifully ſtored with them at all Seaſons of the Year; and I have often wondered, that none of our *Engliſh* Gardeners have yet taken up that Buſineſs, conſidering the Profit which would accrue to them from ſuch an Undertaking: If they are ſtill without Knowledge of the Method of raiſing them, they may be inſtructed how, in our 2d Chapter. The other *French* Kitchen Gardens, contain little more than *Herbs* for Soup and Sallads, almoſt like thoſe in *Holland*.

The next Degree of *Gardens* for Profit, are the Nurſeries of *Foreſt-Timber* and *Fruit-Trees*; the chief of the firſt Sort are thoſe about *Iſleworth*, *Twickenham*, and *Brentford*, which abound in thoſe neceſſary and uſeful Commodities; at which Places are annually raiſed, vaſt Numbers of every Kind of *Tree* which is proper for the Improvement of Land. Nor are the *Gardeners* of this Nation leſs curious in cultivating of *Fruit-Trees*; ſo that I eſteem the Collections we have now in *England*, to exceed all the Nurſeries in *Europe*, for profitable and uſeful Varieties.

We have alſo cultivated in *Eſpalier* the *Bruſſels Abricots* which affords a profitable Crop; but yet, in the moſt perfect *Gardens* which I have obſerved in *England*, I am ſurpriſed that I have not found any Variety of *Figs*, exceeding the old Set of the *Blue Fig*, the *Early White*, the *Long White*, and *one* other Kind. But in *France*, we meet with at leaſt 50 Sorts of *Figs*, which afford as much Variety to the Taſte, as the *Peaches* or *Pears* we have upon our Liſts. There is one Obſervation I cannot omit in this Place, relating to the different Kinds of *Fruit*, which at preſent croud the Nurſeries: Were we to take all the Sorts we have Names for, we ſhould deſpiſe the greater Part; and, I believe, from what I have obſerved abroad, that there are no better *Fruits* than we have among us, becauſe I find little Difference between the Liſts of our Nurſeries, and the *French* Liſts that are ſent over every Year from *Orleans*. For my own Part, I have remarked, that in *Devonſhire*, *Herefordſhire*, and ſome other Parts of *England*, the Seedling *Plants*, raiſed from the *Kernels* of *Pears*, *Apples*, &c. continually afford Varieties of *Fruit*, very different from what we gather from thoſe *Plants* we had the *Seed* from. My curious Friend, *Samuel Reynardſon*, Eſq; of *Hillingdon*, near *Uxbridge*, has likewiſe raiſed ſeveral new Kinds of *Peaches* and *Grapes* from the *Stones* or *Kernels*; ſo that I ſee little Neceſſity for ſeeking out Varieties of *Fruits* in foreign Countries.

The *third* Sort of profitable *Garden* is the Phyſic *Garden*; where, beſides the Collection of *Herbs* uſed in Medicine, we commonly find ſome Variety of ſuch Exotic Rarities from the hotter Climates, as afford the Curious ſufficient Matter of Admiration. The completeſt *Garden* of this Kind, I have yet ſeen, is that at *Amſterdam*; which, altho', it is not of great Extent, yet it affords the greateſt Choice of valuable *Herbs* and *Plants*, agreeable to its Deſign, of any *Garden* in *Europe*. The Method of it is the Claſſing of *Plants* in ſeveral Beds appointed for that Purpoſe; upon which the famous Profeſſors, Drs. *Comellin* and *Ruyſh*, read to the Citizens *twice* every Week; the *firſt*, upon thoſe which are *Exotic*, and the *latter* on the *Domeſtic*. The Governors of this *Garden* are the Chiefs of the City, who take Delight in making it a Nurſery of ſuch *Plants*, as the Trade of their Country will give them Leave to tranſport from the *Eaſt* to the *Weſt Indies*. An Inſtance of which is, that in the Year 1714, when I was there, they raiſed a conſiderable Number of *Coffee Trees* from *Seeds*, which ripened at *Amſterdam* upon two *Plants*, that they firſt ſent from *Africa* to *Batavia*, and from thence to *Holland*; from whence they tranſported them to *Surinam* and *Curaſau*, ſuppoſing they might one Day bring forth profitable Crops that would yield Advantage to their Country; for theſe Places are ſo ſituate, that the Voyage to them is not a *Fourth* of *that* to the *Eaſt-Indies*, or a *Third* to the *African* Coaſt, where *Coffee* grows: And, if ever the *Dutch* ſhould loſe the Eaſtern *Coffee* Trade, or their *Eaſt Indian* Plantations, I expect that *Drug* will be chiefly brought to us from the *Weſt-Indies*, where the *Hollanders* have planted it. It is to the *Amſterdam* Phyſic *Garden* I owe the greateſt Part of that Collection of Curioſities which I once gloried in; and to judge from what *Gardens* I have ſeen in *Europe* of this Order, I muſt do the *Amſterdam Garden* the Juſtice to own, that it exceeds all others in Variety of curious and uſeful *Plants*, from every Quarter of the World.

The next to this, is the *Royal Garden* at *Paris*, where we may obſerve the Medicinal *Plants* ranged in exact Order, by the learned Dr. *Antonine de Juſſieu*, the King's Profeſſor of *Botany*. We find there likewiſe a fine Collection of *Exotic* Curioſities diſpoſed after a regular Manner, and managed with excellent Skill; from whence I drew ſeveral *Plants* that had not been ſeen before in *England*.

The Phyſic *Garden* at *Leyden* is what we may admire for its good Order, and Variety of Foreign *Plants*, under the Direction of the late celebrated Dr. *Boerhaave*. It is here I have found the greateſt Quantity of that extraordinary *Jeſſamine* of *Arabia*, whoſe *Flowers* excel all others in their Odour.

Among the Foreign Phyſick *Gardens*, I might yet mention that at *Piſa* in *Italy*, and the *Gardens* at *Florence* belonging to the Grand Duke of *Tuſcany*; from whence, by his Royal Highneſs's Direction, I have received valuable Preſents of choice *Plants*, rarely to be found in other *European Gardens*.

Our own regular Phyſic *Gardens* are not above *three* in Number; the beſt of which is that at *Chelſea*, belonging to the Company of Apothecaries; where we may obſerve a great Variety of ſuch *Plants* as are uſeful and entertaining to the Curious, as well *Exotics* as *Domeſticks*. The *ſecond* is the Phyſic *Garden* at *Oxford*, improved through the Skill of the late learned Profeſſor Mr. *Jacob Bobart*, who had the Management of it. The *third* is the Phyſic *Garden* at *Edinburgh*, which, according to the Account I have of it, is valuable for a good Collection of uſeful *Plants* in Medicine; but I doubt the Climate of that Country is hardly generous enough to encourage the Growth of ſuch *Plants* as are Natives of the warmer Parts of the World.

To theſe we may add the curious Gardens of particular Perſons, which are famous for their Varieties of valuable *Plants*; the chief of which in *England* are thoſe at *Badminton*, whoſe Rarities were collected by that incomparable Lady the Dutcheſs of *Beaufort*. The *Gardens* belonging to *Samuel Reynardſon*, Eſq; at *Hillendon*, near *Uxbridge*; and the Collection at *Mitcham*, raiſed by Mr. *Du Bois*; and at *Cheame* in *Surrey*, by the Care and Skill of that excellent Floriſt the late reverend *Lumley Lloyd*, D. D. with which we muſt alſo mention that numerous Collection made by the ingenious Mr. *Fairchild* at *Hoxton*, ſuperior to any I have yet named, both at Home and Abroad.

Theſe are the chief of our *Engliſh* Gardens for Curioſity; not to mention my own Collection, which, with more than ten Years Pains and Expence, I got together, and is enough to ſupport the Spirit of *Botany*; and to theſe every Lover of that Science ought to addreſs himſelf, for his Satisfaction in the Knowledge of *Plants*.

But to make good the Title of this Chapter, I come now to ſpeak of *Fruit-Trees*; and the firſt of all the *Orange*, which is now ſo much improved in its Culture, that it is poſſible to have a grafted *Tree* or *Plant* of this Kind in 5 or 6 Months, from the *Seed* or *Kernel*. I have obſerved, that the *Seed* of a *Lemon* will produce a *Plant* much more vigorous than that of an *Orange*, in the ſame Space of Time; and therefore, ſome nice Perſons uſe *Lemon* Stocks rather than *Oranges*; but not more than 4 Months from the *Kernel*, "cut the tender "*Stems* of theſe horizontally, about half an "Inch above the *Ear-Leaves*, and ſlit it down "about half an Inch as in the Figure; and "that your Deſign may be agreeable to the "Laws of Nature, prepare *Cyons* of good "bearing *Trees*, which are then tender in "Shoot, and conformable to the Strength and "Age of the Stock, ſo as to anſwer the Bigneſs of it; and pruning the lower End Wedgewiſe, fix it in the prepared Stock, and tie it "with Worſted, which takes little Room, and "is ſubſervient to Variety of Weather, by "ſtretching or ſhrinking as the Air alters its "Property; over this Binding, put a ſmall "Quantity of graffing Wax, and in a few "Days the *Stock* and *Cyon* are joined, and become as much one Body as other *Graffs* and "*Cyons* will do in 2 Months." As this will do in *Orange-Trees*, I doubt not but every other Kind of *Fruit* may be as eaſily propagated, and then we ſhould enjoy this Satisfaction, that where a *Bud* or *Graff*, in the common Caſe, is hard to be got, we could anſwer our End as well by a tender growing Shoot. But the Excellency of this Diſcovery ſeems to open a new Field of Knowledge, which may be greatly cultivated.

I ſhall next enquire into the common Complaint of thoſe Gentlemen, who wait with Impatience for the *bearing* of the *Fruit-Trees* they have planted; and for that Reaſon I have contrived a Method, which I think will be ſatiſfactory to them; and whereby there is not any Month in the Year, in which they may not plant their *Gardens*, but eſpecially their Walls, with any *Fruits* they deſire; by which Means they will not only gain 2 or 3 Year's Time, but may even bring their *Trees* into their *Gardens* with *Fruit* upon them, and ſo be ſatisfied they poſſeſs the Varieties they deſire.

To do this, I would adviſe them to provide a large Number of Boxes, whoſe Frame and Sides may be taken to Pieces at Pleaſure, each of theſe Boxes to meaſure 18 Inches over, and as many in Depth; in theſe let a Set of *Fruit-Trees* be planted, of the beſt Kinds, and trained up in the ſame that we uſe to thoſe *Trees* which are planted againſt Walls, giving them their regular Pruning from Time to Time, and directing their *Branches* and *Twigs* in the Poſture they ought to lie upon *Eſpaliers* made of *Arbor-poles:* When theſe *Trees* are brought

plate XXVIII.

Fig. I.

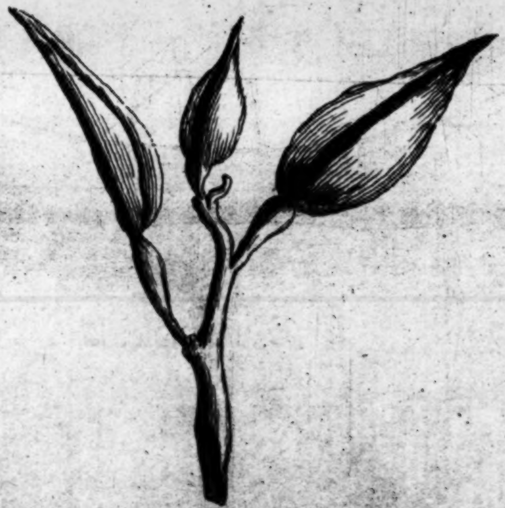
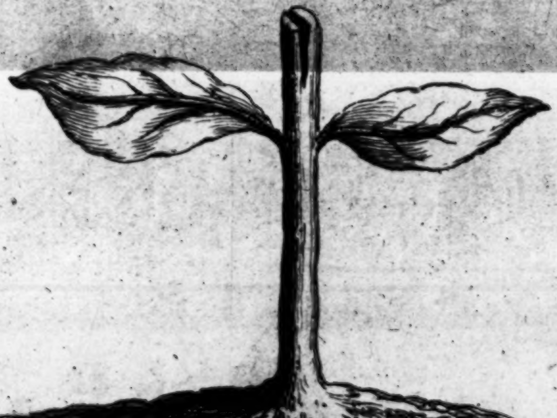


Fig. II.



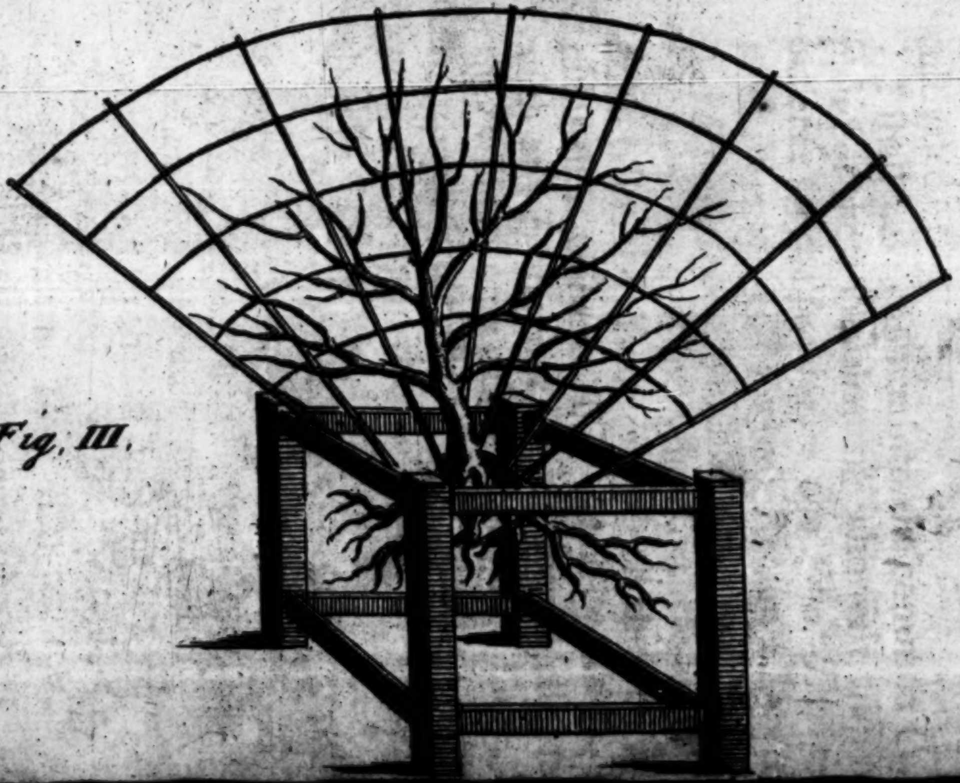


Fig. III.

brought to *bear*, we may tranſport them to any Diſtance with their Caſes, without injuring them; and be it what Seaſon it will, they may be ſet into the Ground at once, with their whole Clump of Earth, and without receiving any Injury. In this Operation, Care muſt be uſed in taking off the Caſes, that the Clump of Earth is not cracked or broken, leſt the Air get in; the Bottom-Board therefore muſt be interred with the *Tree*, and the remaining Parts of the Caſes may ſerve again.

To conclude, I recommend the raiſing of all Sorts of *Flowers* from *Seeds*; and, I think, there can be no greater Motive to encourage our Gardeners to this Undertaking, than directing them to Dr. *Lloyd*'s of *Cheame*, Mr. *Dunklyn*'s at *Clapham*, Mr. *Hunt*'s at *Putney*, and Mr. *Fairchild*'s, where they may obſerve wonderful Collections of *Flowers*, viz. *Ranunculus*, *Bulbous Iris*, &c. lately raiſed from Seminaries diſcreetly made by thoſe Artiſts.

Explanation of the Plates relating to this Chap.

Fig. I. *A* Cyon *cut from a tender Shoot of the* Orange-Tree, *which is the youngeſt* Sprout *that could be cut from thence.*

Fig. II. *A young* Lemon Plant *in its 1ſt Growth, when the* Ear-Leaves *are upon it, agreeable to the Age, Strength, and Bigneſs of the* Graff.

Fig. III. *A* Fruit-Tree *planted in a* Caſe, *and trained up in* Eſpalier, *ſo that it may be planted againſt a Wall at any Seaſon, even in* Flower

or Fruit, *on the Situation we deſire, without injuring the* Tree; *deſigned for the Advantage of ſuch as cannot plant their* Gardens *at their own Time. In this Figure the* Caſe *is ſo contrived, that it may upon this Occaſion be taken to pieces, and returned to the Place it came from, without doing Hurt to the* Plant.

CHAP. XVII.

Of VINES; *the beſt Method of Pruning them; with ſome proper Hints for ſuch as delight in raiſing forward* FRUITS.

THE Opportunities I have lately had of making Obſervations on the Management of *Vines* in *France*, give me Occaſion to mention ſome Improvements which are pleaſant and profitable, and may greatly forward the Ripening of that delicious *Fruit* in *England*.

It is obſervable, that every *Vineyard* in *France* chiefly depends on the *Fruit* produced by *Annual Layers*; for the *Fruits* they *bear* are much larger, and ripe earlier, than what we find growing upon the *Old Stocks*, whoſe greateſt Uſe is to yield *Branches* for the *Layers* of another Year. This leads us to judge of the Method of managing our Wall *Vines*, and directs us to preſerve the young Wood for the ſake of large and good *Fruit*. It is therefore improper to build an high Wall for *Vines*, becauſe all *Old Wood* ſhould be taken away, and the moſt vigorous of *young Shoots* left at due Lengths for a Crop; and in this Caſe we muſt have regard to the Subſtance of the Wood we preſerve: A *Branch*, for Example, whoſe Diameter is about ½ an Inch, may be left a Yard long; a *Branch* of one 3d of an Inch in Thickneſs, about two Foot; and ſo in Proportion; and at the ſame Time, in convenient Places, 2 or 3 *Buds* muſt be kept to ſupply *Branches* for the following Year.

I have likewiſe farther conſidered the Method of Raiſing *Vines*; and among many Experiments I made, I found one, which, I think, will be of extraordinary Uſe, by giving us that Satisfaction which we have long wanted, of planting Sets, or Cuttings of *Vines*, all the Summer Seaſon; ſo that where we are ſure of a *Grape* we like, we may at any Time propagate as many of that Sort as we pleaſe.

In *May*, which is the Month when thoſe Gardeners who have pruned unskilfully, are obliged to diſmember their *Vines* of the crouding *Branches*, then beginning to bud out, we may plant every *Shoot* they pull off with the ſame Succeſs that we are uſed to make Nurſeries of them in *November*, *December*, or any of the Winter Months. In this Practice we muſt cover the Part that is to be interred with common ſoft Soap; and from a *Shoot* thus managed, we are ſure of a ſtrong *Plant* before the colder Seaſons reach us, as I have experienced. By this Method we learn *two* Things; firſt, that Soap is of excellent Uſe to the Improvement of the Growth of *Vines*; and, ſecondly, that we may gain a Year by this *new* Diſcovery: And from the whole I gather thus much, that Soap is the beſt Manure for *Vines* in general.

I next come to deſcribe thoſe Methods now in Uſe for producing of forward *Fruits*, by Means of artificial Heats; ſuch as *Coal* or *Wood-Fires*, or *Horſe-litter*. The firſt is by building Ovens at certain Diſtances at the Back of the Walls, and keeping them continually warm, from *January*, till the Sun's Power is ſufficient of itſelf to maintain the Growth of the *Plants* fixed againſt ſuch Walls, as it is now practiſed at his Grace the Duke of *Rutland*'s, at *Belvoir-Caſtle*, whereby the lateſt Kinds of *Grapes* are commonly ripened about *July*, or *Auguſt*; but in this Method we muſt likewiſe take Notice, that during the cold Seaſon, when theſe *Fruits* are forced to ſhoot unſeaſonably, the *Plants* muſt be covered with Glaſſes, to prevent the Injuries they might receive from Froſts.

But the New Method to force *Cherries*, *Abricots*, and ſome other Kinds of *Fruit*, I take to be much the cheaper Way; which is, by building a Pale 5 or 6 Foot high, compoſed of Inch-Deal-Boards cloſely jointed, on the South of which nail up your *Trees*; and about *December* lay a Coat of Horſe-Dung to the Back, about 3 Foot thick at the Baſe, ſloping, to about a Foot and $\frac{1}{2}$ at the Top, which for about 6 Weeks ſtrikes a Warmth thro' the Boards, ſo agreeable to Vegetation, that the *Plants* bloſſom and diſpoſe themſelves to bear *Fruit* in great Abundance. Here I muſt obſerve, that when the Weather is moderate, you muſt give them what Air you can, by properly opening the Glaſſes which ſtand before them; and when the Litter at the Back of the Pale has loſt its Heat, renew it from Time to Time, till the Seaſon becomes natural to the Growth of *Trees.*

Having now given my Readers what I at firſt propoſed, *viz. A Philoſophical Account of ſome Works of Nature*, in the *Mineral*, *Vegetable*, and *Animal* Parts of the *Creation*, in as many Inſtances as Time would admit for the neceſſary Experiments, *&c.* I am next to inform them, that if this Attempt prove ſatisfactory, a *Scheme* may be carried on ſo uſeful to Mankind, as, by Degrees, may form a *General* and *Compleat* Body of *Experimental-Natural-Philoſophy.*

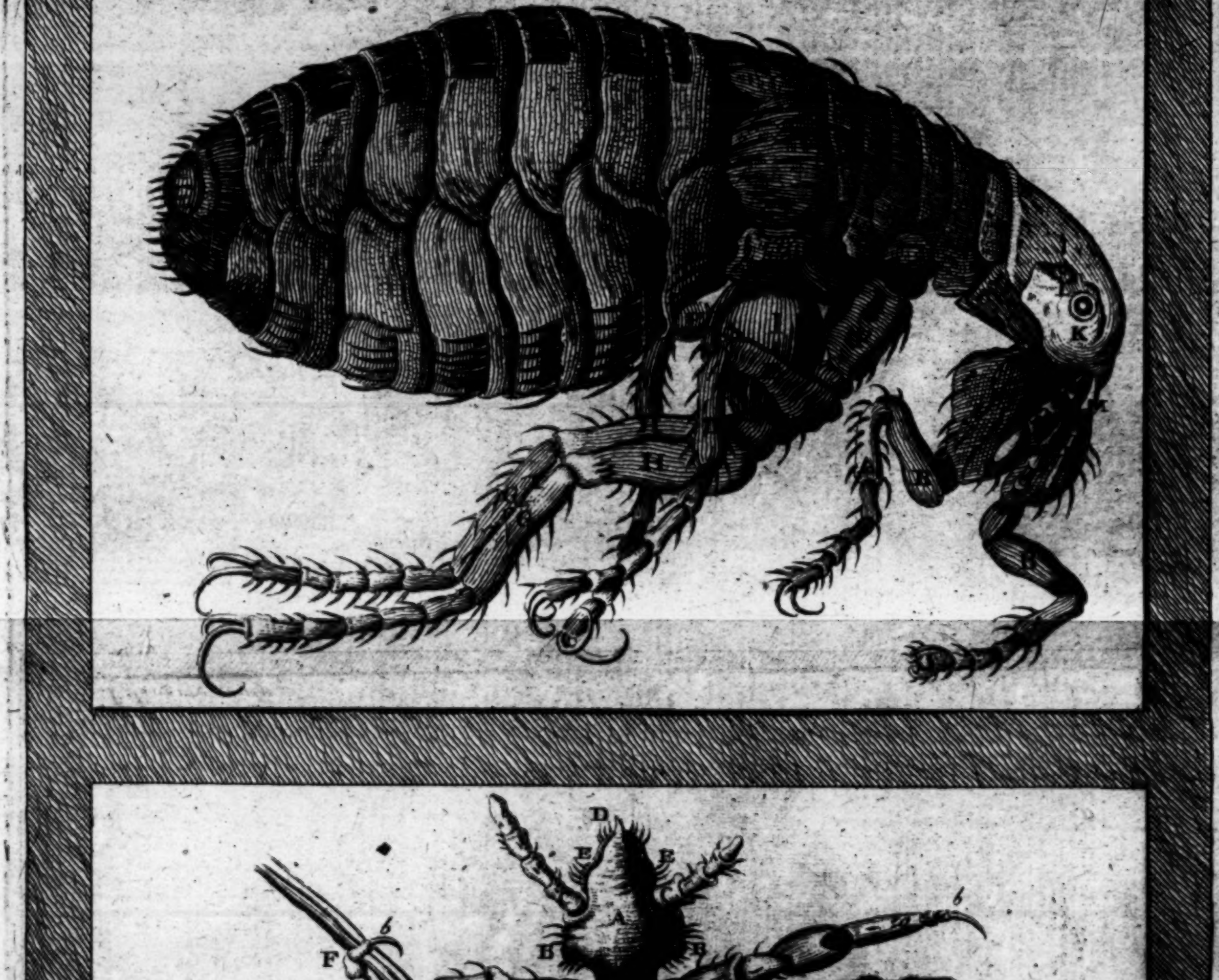
FINIS.

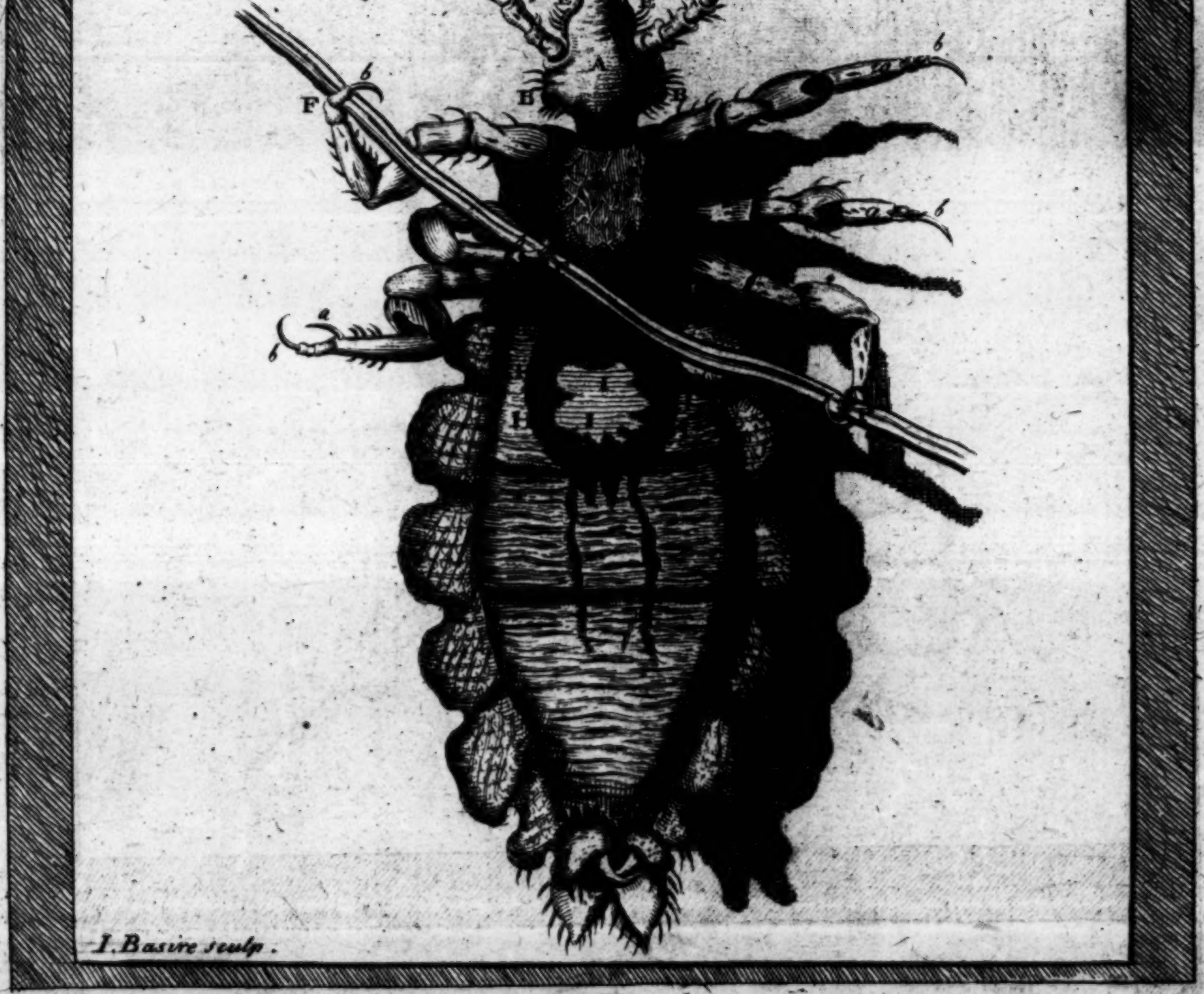
about 6 Weeks [illegible]
Boards, [illegible] in Abundance [illegible]
Hours [illegible] and diminishing [illegible]
Again [illegible] Abundance [illegible]
serve, that when the [illegible]
you must give them [illegible]
very [illegible] the [illegible]
them; and that the [illegible]
Sale has [illegible]
Things [illegible] the [illegible]
Creatures [illegible]

Having [illegible] past my Readers [illegible]
self [illegible] of [illegible]
the Wonders of Nature, in the [illegible]
Globe, and [illegible] Parts of the Earth [illegible]
many Instances [illegible] which [illegible]
receiving Entertainment, &c. I [illegible]
form them, that if this [illegible]
[illegible]
to Mankind [illegible] the [illegible]
Error and [illegible]
their Religion.

FINIS.

Plate XXIX.





I. Basire sculp.

APPENDIX

TO THIS

SECOND EDITION.

Obſervations on the FLEA *and* LOUSE; *By the late ingenious Dr.* HOOKE, F. R. S.

THE Strength and Beauty of the firſt of theſe Creatures, the Flea, had it no other Relation at all to Man, would deſerve a Deſcription.

For its Strength, the Microſcope is able to make no greater Diſcoveries of it than the naked Eye; but only the curious Contrivance of its Legs and Joints, for the exerting that Strength, is very plainly manifeſted, ſuch as no other Creature, I have yet obſerved, has any Thing like it; for the Joints of it are ſo adapted, that he can, as it were, fold them ſhort one within another, and ſuddenly ſtretch, or ſpring them out to their whole Length; that is, of the Fore-Legs, the Part A of Plate XXIX. lies within B, and B within C parallel to, or Side by Side each other; but the Parts of the two next, lie quite contrary; that is, D without E, and E without F, but parallel alſo; but the Parts of the hinder Legs G, H and I, bend one within another, like the Parts of a double-jointed Rule, or like the Foot, Leg, and Thigh of a Man. Theſe ſix Legs he clitches up all together, and when he leaps, ſprings them all out, and thereby exerts his whole Strength at once.

But, as for the Beauty of it, the Microſcope manifeſts it to be all over adorned with a curious poliſhed Suit of ſable Armour, neatly jointed, and beſet with Multitudes of ſharp Pins, ſhaped almoſt like Porcupines Quills, or bright conical Steel-Bodkins; the Head is on either Side beautified with a quick and round black Eye, K, behind each of which alſo appears a ſmall Cavity, L, in which he ſeems to move to and fro a certain thin Film beſet with many ſmall tranſparent Hairs, which probably may be his Ears; in the Forepart of his Head, between the two Fore-Legs, he has two ſmall long jointed Feelers, or rather Smellers, M M, which have four Joints, and are hairy, like thoſe of ſeveral other Creatures; between theſe, it has a ſmall *Proboſcis*, or *Probe*, N N O, that ſeems to conſiſt of a Tube, N N, and a Tongue or Sucker, O, which I have perceived him to ſlip in and out. Beſides theſe, it has two Chaps or Biters, P P, which are ſomewhat like thoſe of an Ant, but I could not perceive them toothed; theſe were ſhaped very like the Blades of a Pair of round-topped Sciſſars, and were opened and ſhut juſt after the ſame Manner; with theſe Inſtruments does this little buſy Creature bite and pierce the Skin, and ſuck out the Blood of Animals, leaving the Skin inflamed with a ſmall round red Spot. Theſe Parts are very difficult to be diſcovered; becauſe, for the moſt Part, they lie covered between the Fore-Legs. There are many other Particulars, which, being more obvious, and affording no great Matter of Information, I ſhall paſs by, and refer the Reader to the Figure.

Of the LOUSE.

THIS is a Creature ſo officious, that it will be known to every one at one Time or other; ſo buſy, and ſo impudent, that it will be intruding itſelf in every one's Company; and ſo proud and aſpiring withal, that it fears not to trample on the beſt, and affects nothing ſo much as a Crown; feeds and lives very high, and that makes it ſo ſaucy, as to pull any one by the Ears that comes in his Way, and will never be quiet till it has drawn Blood: It is troubled at nothing ſo much as at a Man that ſcratches his Head, as knowing that Man is plotting and contriving ſome Miſchief againſt it, and that makes it oftentimes ſculk into ſome meaner and lower Place, and run behind a Man's Back, tho' it go very much againſt the Hair; which ill Conditions of it having made it better known than truſted, would exempt me from making any further Deſcription of it, did not my faithful *Mercury*, my Microſcope, bring me other Information of it. For it has diſcovered to me, by Means of a very bright Light caſt on it, that it is a Creature of a very odd Shape. It has a Head ſhaped like that expreſſed in the Plate marked with A, which ſeems almoſt conical, but is a little flatted on the upper and under Sides; at the biggeſt Part of which, on either Side behind the Head (as it were, being the Place where other Creatures Ears ſtand) are placed its two black ſhining goggle Eyes, B B, looking backwards, and fenced round with ſeveral ſmall *Cilia* or Hairs that encompaſs it, ſo that it ſeems this Creature has no very good Foreſight: It does not ſeem to have any Eye-Lids; and, therefore, perhaps its Eyes were ſo placed, that it might the better cleanſe them with its Fore-Legs; and, perhaps, this may be the Reaſon, why they ſo much avoid and run from the Light behind them; for being made to live in the ſhady and dark Receſſes of the Hair; and thence, probably, their Eyes having a great Aperture, the open and clear Light, eſpecially that of the Sun, muſt needs very much offend them. To ſecure theſe Eyes from receiving any Injury from the Hairs through which it paſſes, it has two Horns that grow before it, in the Place where one would have thought the Eyes ſhould be; each of theſe, C C, hath four Joints, which are fringed, as it were, with ſmall Briſtles, from which to the Tip of its Snout, D, the Head ſeems very round and tapering, ending in a very ſharp Noſe, D, which ſeems to have a ſmall Hole, and to be the Paſſage thro' which he ſucks the Blood. Now, whereas, if it be placed on its Back, with its Belly upwards, as it is in the Plate, it ſeems in ſeveral Poſitions to have a Reſemblance of Chaps, or Jaws, as is repreſented in the Plate by E E, yet in other Poſtures thoſe dark Strokes diſappear; and having kept ſeveral of them in a Box for two or three Days, ſo that for all that Time they had nothing to feed on, I found, upon letting one creep on my Hand, it immediately fell to ſucking, and did neither ſeem to thruſt its Noſe very deep into the Skin, or open any Kind of Mouth, but I could plainly perceive a ſmall Current of Blood, which came directly from its Snout, and paſt into its Belly; and about A. there ſeemed a Contrivance, ſomewhat reſembling a Pump, Pair of Bellows, or Heart; for by a ſwift *Syſtole* and *Diaſtole* the Blood ſeemed drawn from the Noſe, and forced into the Body. It did not ſeem at all, though I viewed it a good while as it was ſucking, to thruſt more of its Noſe into the Skin than the very Snout D, nor did it cauſe the leaſt diſcernible Pain, and yet the Blood ſeemed to run through its Head very quick and freely, ſo that it ſeems there is no Part of the Skin but the Blood is diſperſed into; nay, even into the *Cuticula*; for had it thruſt its whole Noſe in from D to C C, it would not have amounted to the ſuppoſed Thickneſs of that *Tegument*, the Length of the Noſe being not more than a three a three hundredth Part of an Inch. It has ſix Legs, covered with a very tranſparent Shell, and jointed exactly like a Crab's, or Lobſter's; each Leg is divided into ſix Parts by theſe Joints, and thoſe have here and there ſeveral ſmall Hairs; and at the End of each Leg it has two Claws, very properly adapted for its peculiar Uſe, being thereby enabled to walk very ſecurely both on the Skin and Hair: And, indeed, this Contrivance of the Feet is very curious, and could not be made more commodiouſly and compendiouſly, for performing both theſe requiſite Motions, of walking and climbing up the Hair of a Man's Head, than it is; for by having the leſſer Claw (a) ſet ſo much ſhort of the bigger (b) when it walks on the Skin the ſhorter touches not, and then the Feet are the ſame with thoſe of a Mite, and ſeveral other ſmall Inſects; but by Means of the ſmall Joints of the longer Claw it can bend it round, and ſo with both Claws take hold of a Hair, in the Manner repreſented in the Plate, the long tranſparent Cylinder, F F F, being a Man's Hair held by it.

The Thorax ſeemed caſed with another Kind of Subſtance than the Belly; namely, with a thin tranſparent horny Subſtance, which upon the Faſting of the Creature did not grow flaccid; through this I could plainly ſee the Blood, ſucked from my Hand, to be variouſly diſtributed, and moved to and fro; and about G there ſeemed a pretty big white Subſtance, which ſeemed to be moved within its Thorax; beſides, there appeared very many ſmall Milk-white Veſſels, which croſt over the Breaſt between the Legs, out of which, on either Side, were many ſmall Branchings; theſe ſeemed to be the Veins and Arteries, for that which is analogous to Blood in all Inſects is Milk-white.

The Belly is covered with a tranſparent Subſtance likewiſe, but more reſembling a Skin than a Shell; for it is grained all over the Belly juſt like the Skin in the Palms of a Man's Hand, and when the Belly is empty, grows very flaccid and wrinkled; at the upper End of this is placed the Stomach, H H, and perhaps alſo the white Spot, I I; may be the Liver or Pancreas, which, by the periſtaltick Motion of the Guts, is a little moved to and fro, not with a Syſtole and Diaſtole, but rather with a thronging or juſtling Motion. Viewing one of theſe Creatures, after it had faſted two Days, all the hinder Part was lank and flaccid, and the white Spot, I I, hardly moved, moſt of the white Branches diſappeared, and moſt alſo of the Redneſs or ſucked Blood in the Guts, the Periſtaltick Motion of which was ſcarce diſcernible; but upon the ſuffering it to ſuck, it preſently filled the Skin of the Belly, and of the ſix ſcolloped Emboſſments on either Side, as full as it could be ſtuffed; the Stomach and Guts were as full as they could hold; the Periſtaltick Motion of the Guts grew quick, and the juſtling Motion of I I accordingly; Multitudes of Milk-white Veſſels ſeemed quickly filled, and turgid, which were perhaps the Veins and Arteries, and the Creature was ſo greedy, that though it could not contain more, yet it continued ſucking as faſt as ever, and as faſt emptying itſelf behind: The Digeſtion of this Creature muſt needs be very quick, for though I perceived the Blood thicker and blacker when ſucked, yet, when in the Guts, it was of a very lovely ruby Colour, and that Part of it, which was digeſted into the Veins, ſeemed white; whence it appears, that a further Digeſtion of Blood may make it Milk, at leaſt of a reſembling Colour: What elſe is obſervable in the Figure of this Creature, may be ſeen in the Plate.

As theſe Vermin are natural to the Bodies of the human Species, ſo likewiſe, moſt Birds of different Kinds, ſome Sorts of Fiſh, and many Kinds of Quadrupedes have their particular Sorts of Fleas, and Lice, proper and peculiar to themſelves, and manifeſtly differing from each other. Seignior *Redi* having delineated ſome of theſe, I think it will not be foreign to the Subject, to relate the Diſcoveries (he tells us) he made, by the Advantage of a great many Experiments.

In the Hawk, (ſays he) I have obſerved 3 diſtinct Sorts of Fleas, and as many in the *Turkey* Hen; in the Wild-duck four; in the Swan, Wild-gooſe, Keſtrel, and Plover, two:

Yet it muſt be allowed that there is a Sort of Birds that have either the ſame Sorts of Fleas, or ſome that are very like them. The Golden Eagle, and the Bird by the *Italians* called *Vaccaio* from its keeping Company with Cows, as well as the Keſtrel, have very large Ones: Which laſt named Bird hath alſo another Sort of Fleas, no ways differing in Shape from thoſe of the Raven, but of another Colour; and the Raven others, very like the leſſer Sort of Lice found upon the *Egret*. Some of the Buſtard's Fleas, if viewed at a Diſtance, very much reſemble thoſe found upon the *Egret*. On the Wood-pecker and Chaffinch, I have ſeen Fleas reſembling thoſe of the Starling, and on the Wild-duck of the larger Kind, much the ſame Sort of Fleas with thoſe of the Wild-gooſe. In the Feathers of a Crane are to be found Neſts of white Lice, marked, as it were, with *Arabick* or *Algebraick* Characters. Farther, it is remarkable, that the Bigneſs of each Bird's Fleas bears no adequate Proportion to the Bigneſs of the Birds they are found upon; but amongſt the larger Kind of Birds may be found a leſſer and larger Sort of Fleas of a different Kind; and I remember that I have ſeen Fleas upon a Black-bird as large as thoſe found upon a Swan.

If you view Fleas when upon their Feet, there is not the leaſt Appearance of a Mouth to be diſcovered; but if you turn them upon their Backs, you may diſcern the Situation of their Mouth placed on the under Side of the Proboſcis or Trunk, in the Form of a Pair of Pinchers, much reſembling that of the Woodlouſe. In a Word, there is ſuch a wonderful Variety of Fleas of diſtinct Sorts, ſo ſtrangely different one from another, that I thought it much better to exhibit them drawn upon Copper-Plates, than to give the Reader a long and tedious Deſcription of them. As to their Colour, it is generally the ſame, or very near that of the Feathers of the Birds on which they are found. It is true, I am of Opinion (which Experience countenanceth) that Fleas when they are firſt bred out of Nits are white; but as they grow bigger, by Degrees aſſume other Colours, yet ſo that preſerving the Tranſparency of their Bodies, by the Help of a Microſcope, the Motion of their Entrails, and Circulation of their Juices may be very plainly diſcerned.

Obſer-

Obſervations made by an Engliſh *Gentleman upon the Huſbandry of* Flanders.

AFTER I had ſeen the greateſt Part of *Flanders*, and diligently examined the Nature and Condition of the Soil, which in ſome Parts I conceived to be very rich, (in reſpect of the goodly Barley and Wheat which I ſaw it produced, and the excellent Paſture Grounds,) at my Return to *Ghent*, I asked a Merchant, which was the richeſt Part of *Flanders*: He told me, the Land of *Waſſe*, which lay between *Ghent* and *Antwerp*; the which I wondered at, and replied, that in my Opinion it was the pooreſt ſandy Land in all the Country, and that it carried nothing but Rye, Buck-Wheat, and Oats; and in the Highways that were not ploughed, the Ground, of its own Nature, produced Heath. He told me again, that it was the beſt Ground for *Flax*, which was called the Wealth of *Flanders*. I asked him, what an Acre of *Flax* might be worth. He anſwered me, that a Gamett, which was their Acre, might be worth forty or fifty Pounds; and much to the ſame Purpoſe I was afterwards informed by others. Upon this, I deſired to know the Difference between a Gamett and an *Engliſh* Acre; which having learned, I made an *Engliſh* Rod; and, the better to inform myſelf what an Acre might be worth, the next Year I bought an indifferent Rod of *Flax* when it was ripe, which I cauſed to be pulled, watered, and dreſſed by itſelf, and then weighed, that by that Proportion I might come to know the Value of an *Engliſh* Acre; which by that Trial came to 36 *l.* 14 *s.* 6 *d.* I found, that after their *Flax* they ordinarily ſowed *Turnips*, with which the Country People fed both themſelves and their Kine, which afterwards fed them with Plenty of Milk. I found alſo, that when they laid down that Ground from ploughing, they ſowed it with a Clover-graſs Seed, which grew ſo rank and great as I never ſaw any Graſs do in our beſt Meadows in *England*. Upon the underſtanding of all this, I was convinced in my Judgment, and found the Merchant had Reaſon, who told me it was the richeſt Part in *Flanders*; and, having a great Quantity of ſuch natured Ground of my own in *England*, I ſent over Clover-graſs Seed, and cauſed *Flax* to be ſowed, to make a Trial how it would do there, of which I have had ſuch Account as makes me admire the wonderful Bleſſing of Almighty God, from whoſe Bounty and Goodneſs all the Fruits of the Earth do proceed.

I have found by my own Experience, that there is no Ground of a Mold ſo barren, but it may, (by the Labour and Induſtry of Man) be made to produce all Sorts of Grain and Seeds, and all Sorts of *Plants* and *Trees*, which are neceſſary for the Uſe of Man, according to the ſeveral Climates wherein Men live. I would therefore have thoſe younger Brothers, (for whoſe Sake I principally intend my Diſcourſe,) firſt, to take a Farm containing 500 Acres of the moſt barren and heathy Land they can find, ſo as it conſiſteth of a ſandy or hazel Mold, and lies either dry of its own Nature, or ſo as by Art the Water may be drained from it: This Land (which may be had at an eaſy Rent) muſt be firſt *Devonſhired:* But becauſe there are ſeveral Sorts of Husbandry which are to be uſed to improve ſuch Land, according to the Quality or Conveniency of the Place where ſuch Land is ſeated, I will adviſe every younger Brother to begin with a little, until he hath found by his own Experience, what Husbandry ſuiteth beſt with the Condition and Quality of his Ground; that is, what Husbandry is cheapeſt and moſt profitable; and then he may increaſe his Quantity as he ſees Cauſe.

The little Quantity of Ground which I ſhall ſet down for Example's Sake, to begin withal, ſhall be twenty five Acres, which may produce as great Benefit as his eldeſt Brother's Eſtate of 1000 Pounds a Year; and if that prove right, he will be encouraged to proceed in a larger Proportion, whereby he may quickly prove a better Man in Eſtate than his elder Brother; who, perhaps, like an idle Drone, contented with what his Father left him, lives at his Pleaſure and Eaſe, whilſt he by his Induſtry gathers his Profit out of the Bowels of the Earth, which God gave unto Man to that End:

For *vigilantibus*, *non dormientibus*, *dat Deus Incrementum*. But becauſe there are ſeveral Ways to improve Land, and that ſuch heathy and barren Land is not worth the ſowing till it be improved, I will firſt ſet down ſuch ſeveral Ways as I have obſerved for the Purpoſe, and ſo leave it to thoſe that are to reap the Benefit, to make Choice of that they like beſt, and afterwards ſet down, as near as I can, the Charge that is to be laid out to raiſe ſo great a Profit, and then the particular yearly Gain that (I conceive) by God's Bleſſing may ariſe thereby.

Your moſt common Way of improving Land is by Dung, whereof they will reap the greateſt Profit that are ſeated near ſome Market Town, where ordinarily you may buy a great Quantity from the Inns, at 1 *s.* the Load. But becauſe every Man cannot be ſo ſeated, I will teach you an eaſy Way to raiſe Dung, if you can keep but three or 400 Sheep, in Manner following: You muſt houſe them every Night, and in the Summer at Noon; but you muſt firſt lay 3 or 4 Inches of Sand at the Bottom of the Floor, and thereon lodge your Sheep for a Night or two, till their Dung and Piſs be trod into the Sand, and then continually lay on more Sand, and let it be uſed in the ſame Manner, by which Means three or four hundred Sheep will raiſe 1000 Load of Dung a Year, which will richly manure fifty Acres for *Flax*. If you have any Ponds, the Earth of them being caſt, a Year before you uſe it, will be excellent good to mingle with the Dung, and ſo laying about 12 Load upon an Acre to mix with the Aſhes after the Ground is baked and burnt, it will produce you two or three plentiful Crops of whatever Seed you ſhall think fit to ſow. But where there cannot be Dung enough had, I will teach you another Way to improve the Land, where Lime is to be had, which is thus: When you *Devonſhire* your Ground, divide the Hills into eightſcore for every *Rue*, *viz.* a Hill to a Rod, and put into every Hill a Peck of Lime, if you can, before it be ſlaked, and when it is ſlaked in the Midſt of the Hills, which it will be after the firſt Rain, then mingle the Lime and Aſhes together, and ſpread it upon the Land. It is an uſual Thing to lay 4 or 5 Loads of Lime upon an Acre, where the Land is not *Devonſhired:* But I have ſeen the other Way, which is much the cheaper, does extream well for 2 or 3 Crops. If there be Marle in the Ground, I will teach you another Way, but not according to the ordinary Way uſed in *Suſſex*, where they lay 250 or 340 Loads upon an Acre, but in a cheaper Manner, which is thus: Lay 40 Load of Marle in the Summer upon an Acre of heathy and barren Ground, and preſently ſpread it, and let it lie all the Winter until the *March* following, by which Time it will be waſhed into the Ground; then bake and burn it, and ſow the Land. By this Husbandry I have ſeen Ground (that was all Heath as high as one's

Knee) have 2 or 3 Crops of good Corn, and afterwards bring forth as good Clover-Graſs as ever I ſaw grow in *England*.

The next Thing I will lay down, ſhall be the Charge of ploughing and ſowing.

The *Devonſhiring* 25 Acres will coſt 25 *l.*

The Lime a Load an Acre at 40 Buſhels to the Load, and 15 *s.* a Load, 18 *l.* 15 *s.*

The ploughing and harrowing of 25 Acres at 6 *s.* an Acre, 7 *l.*

Four Buſhels of *Flax* Seed to ſow an Acre at 6 *s.* a Buſhel, for 25 Acres, 30 *l.*

Weeding, pulling, ſwingling the *Flax*, and all other Charges, valued at 3 *l.* an Acre, 75 *l.*

The whole Charge amounts to 156 *l.* 5 *s.*

The Intereſt of 156 *l.* 5 *s.* cometh to yearly about 12 *l.* 5 *s.*

And the Rent of the Land at 2 *s.* an Acre, 2 *l.* 10 *s.*

So the Whole amounts to 14 *l.* 15 *s.*

Five and twenty Acres valued according to the Proportion which an indifferent Rod of *Flax* did bear, which was 5 Pound and a Quarter from the Brake at 8 *s.* the Pound, being the ordinary Price in *Ghent*-Market, comes to 33 *l.* 12 *s.* *Engliſh* an Acre, which for 25 Acres is 840 *l.*

The Seed of twenty-five Acres, valued as the ſame Rod did bear, which was five Pound, cometh to 12 Buſhels and a half an Acre, which at 5 *s.* the Buſhel, is 3 *l.* 2 *s.* 6 *d.* the Acre;

Acre: For 25 Acres it is 78 *l.* 2 *s.* 6 *d.* The Whole is 918 *l.* 2 *s.* 6 *d.*

Theſe 25 Acres are to be ſowed with *Flax*, in *March*, *April*, or *May*, and will be ready to pull in the Beginning of *Auguſt* following, and then you may ſow for Turnips, which will be ripe in *October* following, and may be pulled from that Time to the End of *December*. The Turnips about *Ghent* in *Flanders* (beſides what the People eat) are much employed to feed their Kine; and I have a Receipt in my Book, (which I had from People of great Credit,) with which they feed lean Kine with Turnips, Grains, and Waſhings of Barrels of Beer together, that yielded them as much Milk in a Year, as would have coſt them 60 *l.* *Engliſh*, and yet they valued their whole Charge in keeping them not to be above 5 *l.* a Cow, and the Turnips were far the greateſt Charge. But becauſe this Rule ſeemeth to me to be a greater Gain than our Kine will ever yield in *England* (for which there can be no other Reaſon, but that Milk is ſold at a dearer Rate in *Ghent* than it is in *England*) I have not ſet down the Charge of ploughing and ſowing Turnips (which is but a ſmall Matter,) nor the Charge of the Stock of the Kine, becauſe I have reduced them to half the Profit which they make of them in *Ghent*; but I do verily believe, that 25 Acres of good Turnips will keep 15 Kine, and the Profit of 15 Kine to be worth yearly 15 *l.* for each Cow; and ſuppoſe that beſides the Turnips they will eat, there will be as many ſold out of the 25 Acres as will pay for the Grains, and other Charges belonging unto them, and ſo by this Account thoſe 15 Kine will yearly profit 225 *l.*

Which being added unto the 903 *l.* 7 *s.* 6 *d.* on the other Side for the Profit of *Flax*, the Whole makes up 1128 *l.* 7 *s.* 6.

This Profit of *Flax* and Turnips ariſeth from the 25 Acres in 8 or 9 Months, which is from the Beginning of *April* to the latter End of *December*, and then you have three compleat Months left untill *April* again to ſtir up the Ground; and then ſow it with Oats or Barley, together with the Seeds of a Clover-Graſs, whereof 9 Pound will ſow an Acre, and ſo let that Ground reſt, and ſtill plough up freſh Ground in the ſame Manner, and lay it down as before, with Clover-Graſs; and when you have ploughed up all the Heathy Land, you may begin with that again which was firſt layed down with Clover-Graſs. This Clover-Graſs will make your Land yield you as much Profit as the beſt Land in *England*, both for Hay and Graſs; and when you have enough of that Graſs, to keep you a convenient Stock to plough up your own Ground, you may increaſe your Quantity of Tillage, and ſow ſome Corn for your own Proviſion, whereby you will have Straw to keep more Cattle, and thereby raiſe more Dung. But if you find your Profit riſe out of your *Flax* and Turnips but near to what you may by this Relation expect, it will not be worth your Labour to ſow any more Corn than for your own neceſſary Uſe, but to employ your Labour as much as you can in the other, which will yield you ſix Times the Profit of the beſt Corn you can ſow.

To bring the Cattle to eat Turnips, you muſt breed them up from their Dams by Hand, as they do all manner of Cattle in *Flanders*; as Horſes, Beaſts, and Sheep, all which they feed many Times with Turnips, Carrots and Parſnips; and I have ſeen a Horſe that was eating of Graſs, as ſoon as Carrots, cut in ſmall Pieces, were laid before him, forſake the Graſs, and eat them like a Hog: And all *Mechlin* in *Flanders* (where they have as rich Paſtures as any be in *England)* they feed their fat Sheep principally with Carrots in the Winter, and they give both them and Turnips to their fat Beaſts in *Ghent*.

Their Horſes are very large and ſerviceable, and, for the the moſt Part, extraordinary broad-buttocked; the which whether I could attribute it to the Kind of the Horſes, or the Breeding them by Hand, and ſo making them eat Roots or any Thing, or to both: They give them little Hay; but Straw, and Oats, and Bean-Stalks, and Beans chopped together: They let their Mares go to Cart and Plough, till they are ready to foal under the Cart, and preſently ſuckle the Colt, and make it eat Butter-Milk, either with Bran, or Grains warmed, whilſt the Mare is at Plough or Cart; and as ſoon as the Mare is come Home from work, they let the Colt ſuck preſently; and ſay it takes no Hurt. I believe that an handſome *Engliſh* Horſe and theſe Kind of Mares, would breed moſt uſeful Horſes.

They have in *Flanders* a Kind of Sheep between a Place called *Vecue* and *Dixmeire*, that ordinarily bring 5 or 6 Lambs a-piece, and by feeding the Ewes with Roots, and bringing the Lambs to eat any Thing, they will all come to good: The like, no Queſtion, we may do in *England*, if we get the ſame Breed of Sheep; and that it is the Kind of their Horſes and of their Sheep, that makes exceed ours, I do the rather believe, becauſe their Beaſts in *Flanders* (even in the richeſt Parts) are not generally compared (neither in Bigneſs nor Handſomeneſs) to our Beaſts of *England*; and why ſhould they not exceed our Beaſts, as well as our Horſes, if it were not the Kind, and not the Feed? The like is in the Capons: For the Kind of a *Bruges* Capon is as big as two *Engliſh* Capons; yet here at *Ghent* their Veal is cried up beyond any Part of the Country, which if there be not as good in *England*, you may have it as good by feeding it thus: Their Calves, being preſently taken from the Cow, and suckled by Hand, as ſoon as the Cow's Milk is good, they feed them with nothing but Butter-Milk, until they can eat Turnips and Carrots maſhed, as they feed their Kine, or until a Fortnight or 3 Weeks before they kill them (which they do ſeldom till they be a Quarter old) and then for that Fortnight or 3 Weeks, they give them as much New-Milk as they will drink thrice a Day, and that makes them fat; and indeed it is as good, and as white as I have ſeen any.

Their Hogs be likewiſe here very large and fat; which are kept up and fed moſt with Carrots and ſome Turnips, and fatted altogether with Buck-Wheat. There are very few Warrens in their Country; but Abundance of tame Coneys, ſo big and fat, as I never ſaw any in *England:* They are fed with Turnips, but moſt with Carrots, and now and then ſome Bran, or a few Oats. I do believe that a Warren of ſome 3 or 4 Acres well fenced in, (if the Coneys be fed in this Manner) would breed enough to keep a very good Houſe. Moſt of the Pigeons of this Country are likewiſe tame, and they are fed moſt with Buck-Wheat, and ſometimes with *Flax*-Seed, which makes them luſty, and breed a-pace.

This Buck-Wheat they uſe much in their Beer, which is commonly very good; and I have heard an *Engliſh* Doctor of good Repute affirm, that Buck-Wheat is as wholſome a Grain as any grows in *England*; and that they make fine Puddings of it in *Italy*; and, to confirm this Opinion, he ſhewed me an Author of great Repute amongſt the Phyſicians. They alſo feed their Capons here with Buck-Wheat and Butter-Milk. The next neceſſary Thing to a Houſe is, a good Kitchen-Garden and Orchard, which may, at all Times and Seaſons, yield you all Manner of Sallads, Turnips, Carrots, Parſnips, Scarots, Beetranees, Savayon, Beans, Peaſe, Artichokes, Aſparagus, and the like.

There is another pretty Commodity to be raiſed with a very ſmall Charge; which is, out of a Bee-Garden, of which there are many in the New-Foreſt in *England*, which are worth 40 or 50 Pounds a Year, although the Honey that is gathered from Heath, is not reputed ſo good as that which is gathered from better Flowers. The reſt of your Land, beſides what you plough, will yield you a conſiderable Profit, in keeping the Sheep and young Beaſts: So with the Addition of theſe Commodities unto the Main (which are the *Flax* and Turnips,) a younger Brother may both live, and quickly grow rich; ſo as he manageth the Affairs of this World with one Hand, and lay hold of the Providence of God with the other,

But when God hath ſent you the Fruits of the Earth in a plentiful Manner, you muſt have a care that the *Engliſh* Proverb be not fulfilled, which is commonly uſed when Meat is ill dreſſed, *viz. Though God ſends Meat, yet the Devil ſends Cooks.* So let the *Flax* be never ſo good, if you have not thoſe that know when it is fit to pull, you ſhall loſe infinitely in the Weight of the *Flax*, (from whence ariſes the greateſt Profit) if you let it ſtand till the Seed is ripe, or in the watering your *Flax*; for if you have not thoſe that know when it is fit to take it out, or if you let it lie too long in the Water, it will rot;

or if you take it out too ſoon, it will not break; or in the letting it lie too long abroad a-drying, or without turning it often after it is taken out of the Water: If any of theſe Miſchiefs happen, it is enough to diſcourage a young Beginner: Therefore let me adviſe you, firſt to take ſome experienced Man and Woman out of *Flanders*, where all Things concerning *Flax* are as common, in courſe of Husbandry, as ſowing and threſhing of Corn in *England*.

Your *Flax* being made fit for Sale, you muſt carry a Pattern of it to *London*, where if you cannot ſell it to your Content, you muſt enquire out ſome Merchant to vent it for you beyond Sea, where the greateſt Trade of making Cloth is, as at *Harlem* in *Holland*, or elſewhere: For it is not prohibited to be tranſported beyond Sea as Corn is: Or it may be in Time, when you are grown before-hand with the World, you may think fit to ſet up a Manufactory of Cloth your ſelf, and then it will vent at *London*, as well as any Commodity the Kingdom will afford. But howſoever, I would have you keep as much *Flax* as will ſet all the poor People about you at Work to ſpin into Thread, and by that you may be both a good Gainer, and do a charitable Act, for which God will bleſs your Labours the better, and you ſhall be ſure to have ready Money at *London* for the Thread, it being as vendible there as any other Thing is. Although I have ſet down 25 Acres to be ſown with *Flax* for a Trial, which you may ſee to be managed with

160 *l.* Stock; yet I ſuppoſe that there is no Man ſo ſimple, but when he findeth the great Benefit of 25 Acres, will the next Year ſow 50 Acres, which a Man may eaſily manure by one of thoſe Husbandries which I have formerly expreſſed; out of which I make good my Aſſertion thus: Fifty Acres, by the former Account in *Flax* and Turnips, cometh to above 2250 *l.* a Year, beſides all other Commodities that may be raiſed out of that by Land, by Beaſts, Sheep, and other Things. Fifty Acres yearly laid down with Clover-Graſs (though upon an Experiment of it in *England*, I had Word ſent me, an Acre was worth 3 *l.* yet I will value it at 2 *l.*) improves yearly 100 *l.* and in 10 Years 500 Acres of heathy Land improveth to 1000 *l.* a Year, and ſo by that Means alone, the younger Brother hath attained to his eldeſt Brother's Eſtate. But then compute what he may have in ten Years out of the 2250 *l.* a Year abovementioned: He may be able to double his eldeſt Brother's Eſtate in 10 Years; nay, may treble it, if he increaſes his Quantity of Acres of *Flax* to an 100 Acres, and finds ready Money for that Commodity.

I do know their Clover-Graſs in *Flanders* continues but 3 Years perfect after it is ſowed; but the Reaſon of that is, becauſe they always cut it green 3 Times a Year, (except ſome that they leave for Seed) and that kills it, as it will do Fern: But let it grow to Hay, and be ſo ripe before you cut it, that ſome of the Seed may, in the Making, ſhatter upon the Ground, and it will always continue after it is once planted.

Here are greater Carps in *Ghent* than any we have in *England*, and becauſe I have obſerved ſeveral Ways in *England*; whereby the muddy and lean Carps may be made in Time both ſweet and fat, I will expreſs them as followeth.

Firſt, for breeding of *Fiſh*: If you have but any Clay-Pit, that is, for Example, but twenty or thirty Rod ſquare, throw ſome Boughs into it, or Log, whereby the Fiſh may hang her Spawn, and put into it either one Spawner and two Milters, or two Spawners and three or four Milters; and they will breed you Carps enough to ſtore twenty, nay, may be, forty Acres of Pond. For I had once out of a Pond that was not above 40 Rod ſquare, of 2 Spawners and 3 Milters, fourteen thouſand and odd hundred Carps, that were bred there in one Year. To make the Fiſh ſweet and fat, the Way is to have two or three little Stews, one of them always dry and graſſed, that you can fill it with Water when you pleaſe, to put in your muddy and lean Fiſh, and in a Month they will grow ſweet and fat. Another Way is, to take a Buſhel or two of Grains, and mingle with them as much Chalk and Marle, or Clay dried, and beat it to Duſt, and make it all together into a Paſte, and ram it hard into a Barrel, where you muſt make ſeveral Holes for the Carps to put in their Heads, and then throw it into the Pond, and it will fat your Carps exceedingly.

Another Way is to lay a Pond dry, and ſow it with Barley, and when it is grown as long as your Hand, then fill it with Water, and put your Fiſh into it, and they will grow ſweet, and fat exceedingly: But for ſuch Carps as you mean to feed, let them be Milters or barren Carps, for you ſhall ſeldom ſee a Spawner fat.

Amongſt the ſeveral Obſervations before made, the main Profit to make a Man rich indeed, is the *Flax*; Concerning which I have had a Queſtion asked me, Why they do not ſow all their Land with *Flax*, if it bring ſuch huge Profit beyond other Commodities? and why theſe Men that ſow it are not infinitely rich? For which I confeſs (tho' I am well ſatisfied in the Truth of the Thing by thoſe Experiments I have made) I could never learn other Anſwers, than theſe: Firſt, that all the Land is not natural for *Flax*; and namely, no Land, but either a Sand or a light Loam; bebecauſe the Ground where it is ſowed muſt be made as fine as any Garden Mould; for your *Flax* will not grow kindly where there is any Clot, or Stones. Secondly, for that the Seed is ſome Years very chargeable, and has been ſold in *Ghent* at 15 Shillings a Buſhel, by reaſon your outlandiſh Seed came not over in Time, which moſt Husbandmen buy to ſow their Land, having converted their own

Seed before to Oil; and ſo a Gamet, upon which they ſow their 6 Buſhels, will coſt in Seed 4 *l.* 10 *s.* And if there come not Rain in ten or twelve Days after the Seed is ſown, their Crop (they make account) is as good as loſt, unleſs they ſow it again. And that is one Reaſon makes poor People, they dare not venture to ſow much; and they are not ordinarily ſo much ſubject to Rain there as we are in *England*, ours being an Iſland, and their's a Continent. Another Reaſon is, becauſe few Men that are Owners of Land there live upon it themſelves, for fear of its being perpetually ſpoiled by Soldiers; and therefore they all live in walled Towns, and let out their Land to Boors, whom they tie by Covenants not to ſow any great Quantity of Land with *Flax*, becauſe they have an Opinion that it barrens the Land, and will not let them ſow the ſame Land but once in ſeven Years; but I think it is rather for fear they ſhould grow too rich. Another Reaſon, becauſe almoſt all their Land that can be ploughed is kept in perpetual Tillage with one Seed or other; and they have no Help but Dung, of which they have but ſmall Quantity, in reſpect they have no waſte Land, and therefore can keep very few Cattle or Sheep to raiſe it; but moſt of theſe Inconveniencies will be remedied in *England*.

Note, As I have already obſerved, when you have ploughed up all your heathy Land, you may break up that Land for *Flax* and Turnips, which you firſt laid down with Clover-Graſs. Becauſe you ſhall not think much to do it, you may obſerve, by this Diſcourſe, that fifty Acres ſown with Flax and Turnips, if it prove right, is more worth yearly than a thouſand Acres of Clover-Graſs, which will alſo require ten Times the Stock more.

The Way concerning the Huſbandry in general of FLAX.

YOU muſt firſt chuſe ſandy or loamy Ground, and manure it well, and lay it as fine as poſſibly you can; and then be ſure to chuſe good Seed, and ſow at leaſt four Buſhels of it upon an *Engliſh* Acre, and chuſe ſuch a Time to ſow it in, as probably, by Signs of the Wind or Weather, you may, by God's Bleſſing, have ſome Rain within ten Days after it is ſowed; for your Seaſon will laſt in *England* to ſow it, from *Mid-March* until a Week in *June*; albeit *April* be the beſt Seaſon of the Year, in regard the nippingeſt Froſts are paſt by that Time, and for that, in that Month, you are likelieſt to have Rain. When the Flax is grown a Handful high, you muſt weed it; and although you tread or lie upon it at that Height, it will riſe again: When the Buttons of the Flax begin to look brown, you muſt pull the Flax, and then comb off the Buttons, and lay them abroad, where they may dry; and as the Outſide withers,

thers, the Flax-Seed will ripen within; but that Seed will be only fit to make Oil, but not to ſow: For if you will ſave any Seed to ſow, you muſt let your Flax ſtand until your Seed be thorough ripe, and then you loſe very much in the Weight of the Flax, which is otherwiſe more profitable to you by much than your Seed. After you have combed off the Buttons, you muſt preſently put your Flax in Water, but it muſt be ſtanding Water, and ſuch as will not diſcolour it; where it muſt be about ſeven or eight Days ordinarily: But that Rule is ordered according as the Weather proves hotter or colder. Then it muſt be ſeven or eight Days laid out a drying, being now and then turned; and when it is dry enough, it muſt be put into a Barn, where it muſt lie in Heaps ſeven or eight Days more a ſweating, before you muſt do any Thing elſe to it. But to order the Buſineſs well, you muſt be ſure to have one of Experience until you can come to underſtand every Particular yourſelf. When it hath ſweat enough in the Barn, then it muſt be beaten, or breaked, or hackled, and then it is fit for the Market.

After you have pulled your Flax, you muſt then plough your Ground for Turnips. Two Pound and a Half of Turnip Seed will ſow an Acre. After your Turnips be off, in *April* following you may ſow the ſame Ground with Barley or Oats, and with it ſow your Clover-Graſs, whereof nine Pound will ſow an Acre; and by that Time you have mowed your Oats, your Ground will be ſtocked with Clover-Graſs.

A Way to make infinite Profit by SKAROTS.

YOU muſt let as many Skarots lie in the Ground all Winter as you think neceſſary for Plants: They will be ſprouted up in *March*, and then you muſt divide the Top of the Root into ſingle Plants. Plant them in rainy Weather, they will be ready to eat by *Chriſtmas*. You muſt dung the Ground for them every Year where you ſow them: Cow Dung is the beſt; but never ſow the ſame Land with them two Years together. Thoſe which come of Seed the firſt Year, are never ſo good as thoſe which are tranſplanted; and the Plants ſeldom fail if they be planted in moiſt Weather. If they be trod about the Roots they will thrive the better; and they do not prove beſt in a light Land. You may keep them as long as you will after you have taken them up, laying a Lane of Earth, and a Lane of Skarots ſtill one upon another; or you may let them lie in the Ground till *Eaſter*. They never cut the Stalks, but let them wither of themſelves.

An *Engliſh* Rod of ſixteen Foot and a half Square, is thirty-three half Foot ſquare; and your Skarots being planted half a Foot one from another, a Rod of Ground will contain one thouſand and eighty nine Plants; every Plant that grows may very well produce three and four Roots; but becauſe ſome Plants may fail, compute not the odd eighty nine, but ſuppoſe you may have three thouſand Roots out of a thouſand Plants; and twelve Roots being ſold for a Stiver, the three thouſand upon a Rod come to 25*s.* *Engliſh*, but if ſold for an *Engliſh* Penny, come but to 20*s.* and 10*d.* But according to that Account, there being eightſcore Rod to an Acre, an Acre is worth 166*l.* 13*s.* 11*d.*

If you think your Skarots will be eaten with Worms, than dreſs your Land with Lime, *viz.* Lay four Load upon an Acre, *viz.* a Buſhel upon a Rod, there being eightſcore Buſhels in four Load, and uſe it in this Manner: Take your Lime unſlaked from the Kiln; and after you have digged up your Land, cover your Lime a good Thickneſs with the Earth, ſo as there may be three or four Load of Earth to cover a Buſhel of Lime, and there let it ſlake in the Earth; and then before you ſet your Skarots, mingle the Lime and Earth together, and ſpread it upon the Land, and that will keep away the Worms.

Of Roman BEANS.

AN *Engliſh* Merchant carried from *Flanders* into *England* ſome *Roman* Beans, that yielded him an Increaſe of two hundred and fifty Beans for one, and by only ſetting an Handful or two, he had the next Year as many as he made forty Pounds of, by ſelling them to a Corn-Chandler near *Strand-Bridge*, at ſixteen Shillings the Buſhel. Theſe Beans are to be ſet about *Mid-May*, at half a Foot diſtance from one another, and afterwards to be brought to Poles like Hops.

To inform myſelf of the Commodity and Profit of theſe Beans, I bought a Pint, which coſt me three Stivers, and told all the Beans of that Pint, which were eight hundred and forty-four: I doubled them to a Quart, which was ſixteen hundred and eighty eight; then to a Pottle, which was three thouſand three hundred and ſeventy ſix; then to a Gallon, which was ſix thouſand ſeven hundred and fifty two; then to eight Gallons, which is a Buſhel by our *Engliſh* Statute Meaſure, which contained fifty four thouſand and ſixteen Beans: Then I caſt up how many Beans might be ſet upon an *Engliſh* Rod, which was thirty-three half Foot ſquare, at half a Foot aſunder, and I found it would take up one thouſand and eighty-nine Beans; and that by the ſame Account, there might be ſet upon an Acre, which was eightſcore Rod, 174,240, which was three Buſhel, and 12,092 Beans over, which was near a Peck more. I then computed what Beans were uſually ſold at in *Ghent*, which was three Stivers a Pint; which amounted to nineteen Shillings *Engliſh* the Buſhel: I computed then what Charge belonged to a Rod, according to the *Engliſh* Account, as followeth:

Firſt, I valued an Acre of Land at 13 *s.* 4 *d.*

So a Rod is but 1 *d.*

Half a Quarter of a Load of Dung to dreſs a Rod, according to twenty Load to an Acre, 1 *d.* ½.

Trenching a Rod worth 3 *d.*

A Pint and Quarter and thirty-four Beans, being in all one thouſand and eighty-nine Beans, 4 *d.* ½.

The Poles, an hundred and twenty-one, at 3 *s.* a hundred, allowing the Branches of nine Beans to a Pole, 16 *s.*

The ſetting, poling, pulling, *&c.* 8 *d.*

So the whole Charge of a Rod comes to 7 *s.* 6 *d.*

Now, if a Pint, and a Quarter, and thirty-four Beans do produce two hundred and fifty Times as many, then a Rod reckoned at 250 *l.* 4 *d.* ½ cometh to 4 *l.* 13 *s.* 9 *d.*

Then deducting the Charge of 7 *s.* 6 *d.* there is clear Gain in a Rod 4 *l.* 6 *s.* 3 *d.*

According to which Account, compute the Gain of one hundred and ſixty Rod, which is an Acre, 750 *l.*

Out of which is to be deducted eightſcore Times 7 *s.* 6 *d.* for Charges, 60 *l.*

So there remaineth clear Gain for an Acre 690 *l*

But your Poles, which is the greateſt, will laſt five or ſix Years.

The only Way to vent theſe Beans, is to ſell them for the Uſe of the Navy, or to Merchant Ships.

To raiſe Sallads, Pulſe, and all Sort of Grain in a ſhort Time.

IT is to be obſerved, that that which renders a Piece of Ground more fertile and productive than another, is the Quantity of the Nitre in it: So that if Seeds can receive ſuch a Quantity of Nitre as is ſufficient, before they are thrown in the Earth, they will ſhoot with Precipitation.

Tho' Wheat Water is mentioned in the Compoſition underneath, it is not abſolutely neceſſary. I have found, that common Water (Rain Water, if it can be had) in which good rotten Horſe Dung, or rather Sheeps Dung, has been ſteeped, will do as well; in which ſome refined Salt Petre muſt be diſſolved. This is all the Myſtery. In this Liquor Seeds are to be ſteeped more or leſs, according to their Qualities.

As to the exact Quantity of Salt Petre, it is difficult to fix it. Experience in this Caſe is the beſt Guide. Too much would burn the Seeds, and too little would not anſwer the End. But according to the Proportions that I have tried, it is as follows.

Take about a Pail and a Half of Water, ſteep in it a Buſhel of new Wheat, boil it till the Wheat is ready to burſt: When it is cold, ſtrain this Water, and the Wheat, to get out all the Subſtance. Add to this about two Pails of Dung Water aforementioned, and a Quarter of a Pound of refined Salt Petre, and two Pound and Half of Sheeps Dung. Boil this all together, ſtirring it well till the Salt Petre and Sheeps Dung be diſſolved. When it is cold, put in your Wheat, Peaſe, or Beans, to ſteep: The Wheat about twelve Hours, unleſs you obſerve that it begins to ſhoot ſooner: Then take it out, and lay it upon Boards in the Shade, and turn it often and gently, till it be almoſt dry, then ſow it; and one Grain of ſuch Wheat will produce thirty or forty Ears of Corn.

Peaſe muſt ſteep as long as Wheat, Beans ſomething leſs.

As for other Seeds, the Judgment of the Perſon that makes the Experiment muſt be the Rule. For ſome will grow ſoft in Water much ſooner than others.

This Water is very good for all Sorts of Fruit Trees. The Root muſt be opened a little, and ſome of this Water thrown on it, and the Earth round watered with it.

FINIS.

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